NP6

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FortiOS™ Handbook - Hardware Acceleration

VERSION 5.6.6

FORTIOS 5.6 VERSION

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September 13, 2018

FortiOS™ Handbook - Hardware Acceleration

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Change log

Date	Change Description
September 13, 2018	FortiOS 5.6.6 document release. New section, NP6 processors and redundant interfaces on page 35.
May 9, 2018	Corrected NP6 processors and traffic shaping on page 31 and Enabling bandwidth control between the ISF and NP6 XAUI ports on page 48.
April 26, 2018	Updated for FortiOS 5.6.4, see Whats New in Hardware Acceleration for FortiOS 5.6 on page 9.
March 14, 2018	Added the following sections: • FortiGate-300E and 301E fast path architecture on page 51 • FortiGate-500E and 501E fast path architecture on page 54
February 21, 2018	The FortiGate-3800D, 3810E, and 3815D fast path diagrams incorrectly included the CP9 processor. This error has been corrected in this new version.
December 21, 2017	Updated for FortiOS 5.6.3 by adding Enabling bandwidth control between the ISF and NP6 XAUI ports on page 48, and NP6 session drift on page 49. Also updated Whats New in Hardware Acceleration for FortiOS 5.6 on page 9.
Sept 25, 2017	Corrected the information in FortiGate-1500DT fast path architecture on page 65.
September 22, 2017	Reviewed and corrected descriptions of the config system npu command options throughout the document (including in Whats New in Hardware Acceleration for FortiOS 5.6 on page 9).
September 13, 2017	Corrected the list of models in the section NP Direct on page 32.
September 11. 2017	Initial version.

This document describes the Security Processing Unit (SPU) hardware that Fortinet builds into FortiGate devices to accelerate traffic through FortiGate units. Three types of SPUs are described:

- Content processors (CPs) that accelerate a wide range of security functions
- Security processors (SPs) that accelerate specific security functions
- Network processors (NPs and NPLites) that offload network traffic to specialized hardware that is optimized to provide high levels of network throughput.

This FortiOS Handbook chapter contains the following sections:

Hardware acceleration overview describes the capabilities of FortiGate content processors (CPs), security processors (SPs) and network processors (NPs). This chapter also describes how to determine the hardware acceleration components installed in your FortiGate unit and contains some configuration details and examples.

NP6 and NP6lite Acceleration describes the FortiGate NP6 network processor.

FortiGate NP6 architectures contains details about the network processing architectures of FortiGate units that contain NP6 processors.

FortiGate NP6lite architectures on page 100 contains details about the network processing architectures of FortiGate units that contain NP6Lite processors.

NP4 and NP4Lite Acceleration describes the FortiGate NP4 network processor.

FortiGate NP4 architectures contains details about the network processing architectures of FortiGate units that contain NP4 processors.

Whats New in Hardware Acceleration for FortiOS 5.6

The following new hardware acceleration feature has been added to FortiOS 5.6.4.

- Per-session accounting is supported for FortiGates with NP6lite processors, Enabling per-session accounting for offloaded NP6 or NP6lite sessions on page 45.

Bandwidth control between the ISF and NP6 XAUI ports (437911)

In some cases, the Internal Switch Fabric (ISF) buffer size may be larger than the buffer size of an NP6 XAUI port that receives traffic from the ISF. If this happens, burst traffic from the ISF may exceed the capacity of an XAUI port and sessions may be dropped.

You can use the following command to configure bandwidth control between the ISF and XAUI ports. Enabling bandwidth control can smooth burst traffic and keep the XAUI ports from getting overwhelmed and dropping sessions.

Use the following command to enable bandwidth control:

```
config system npu
   set sw-np-bandwidth {0G | 2G | 4G | 5G | 6G}
end
```

The default setting is `0G` which means no bandwidth control. The other options limit the bandwidth to 2Gbps, 4Gbps and so on.

SNMP/CLI monitoring capabilities of NP6 session table and session drift (441532)

In some cases sessions processed by NP6 processors may fail to be deleted leading to a large number of idle sessions. This is called session drift. New monitoring capabilities have been added to allow you to use SNMP to be alerted when the number of idle sessions becomes high. The SNMP fields allow you to see which NP6 processor has the abnormal number of idle sessions and you can use a diagnose command to delete them.

You can use the following diagnose command to determine of drift is occurring:

```
diagnose npu np6 sse-drift-summary
NPU   drv-drift
----- ---------
np6_0 0
np6_1 0
----- ---------
Sum   0
----- ---------
```

The command output shows a drift summary for all the NP6 processors in the system, and shows the total drift. Normally the sum is 0. The previous command output, from a FortiGate-1500D, shows that the 1500D's two NP6 processors are not experiencing any drift.

If the sum is not zero, then extra idle sessions may be accumulating. You can use the following command to delete those sessions:

```
diagnose npu np6 sse-purge-drift <np6_id> [<time>]
```

Where `<np6_id>` is the number (starting with NP6_0 with a np6_id of 0) of the NP6 processor for which to delete idle sessions. `<time>` is the age in seconds of the idle sessions to be deleted. All idle sessions this age and older are deleted. The default time is 300 seconds.

The `diagnose npu np6 sse-stats <np6_id>` command output also includes a `drv-drift` field that shows the total drift for one NP6 processor.

For SNMP monitoring, the following MIB fields have been added. These fields allow you to use SNMP to monitor more session table information for NP6 processors including drift for each NP6 processor.

```
FORTINET-FORTIGATE-MIB::fgNPUNumber.0 = INTEGER: 2
FORTINET-FORTIGATE-MIB::fgNPUName.0 = STRING: NP6
FORTINET-FORTIGATE-MIB::fgNPUDrvDriftSum.0 = INTEGER: 0
FORTINET-FORTIGATE-MIB::fgNPUIndex.0 = INTEGER: 0
FORTINET-FORTIGATE-MIB::fgNPUIndex.1 = INTEGER: 1
FORTINET-FORTIGATE-MIB::fgNPUSessionTblSize.0 = Gauge32: 33554432
FORTINET-FORTIGATE-MIB::fgNPUSessionTblSize.1 = Gauge32: 33554432
FORTINET-FORTIGATE-MIB::fgNPUSessionCount.0 = Gauge32: 0
FORTINET-FORTIGATE-MIB::fgNPUSessionCount.1 = Gauge32: 0
FORTINET-FORTIGATE-MIB::fgNPUDrvDrift.0 = INTEGER: 0
FORTINET-FORTIGATE-MIB::fgNPUDrvDrift.1 = INTEGER: 0
```

NP6 Host Protection Engine (HPE) adds protection for DDoS attacks (363398)

NP6 processors now include HPE functionality that can protect networks from DoS attacks by categorizing incoming packets based on packet rate and processing cost and applying packet shaping to packets that can cause DoS attacks. You can use the options in the following CLI command to limit the number packets per second received for various packet types by each NP6 processor. This rate limiting is applied very efficiently because it is done in hardware by the NP6 processor.

HPE protection is disable by default. You can use the following command to enable HPE protection for the NP6_0 NP6 processor:

```
config system np6
   edit np6_0
      config hpe
         set enable-shaper enable
      end
```

HPE can be enabled and configured separately for each NP6 processor. When enabled, the default configuration is designed to provide basic DoS protection. You can use the following command to adjust the HPE settings in real time if you network is experiencing an attack. For example, the following command allows you to configure HPE settings for np6_0.

```
config system np6
   edit np6_0
      config hpe
         set tcpsyn-max
         set tcp-max
         set udp-max
         set icmp-max
         set sctp-max
         set esp-max
         set ip-frag-max
         set ip-others-max
         set arp-max
         set l2-others-max
         set enable-shaper {disable | enable}
      end
```

Where:

`tcpsyn-max` applies shaping based on the maximum number of TCP SYN packets received per second. The range is 10,000 to 4,000,000,000 pps. The default limits the number of packets per second to 5,000,000 pps.

`tcp-max` applies shaping based on the maximum number of TCP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 5,000,000 pps.

`udp-max` applies shaping based on the maximum number of UDP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 5,000,000 pps.

`icmp-max` applies shaping based on the maximum number of ICMP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 1,000,000 pps.

`sctp-max` applies shaping based on the maximum number of SCTP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.

`esp-max` NPU HPE shaping based on the maximum number of IPsec ESP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.

`ip-frag-max` applies shaping based on the maximum number of fragmented IP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.

`ip-others-max` applies shaping based on the maximum number of other IP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.

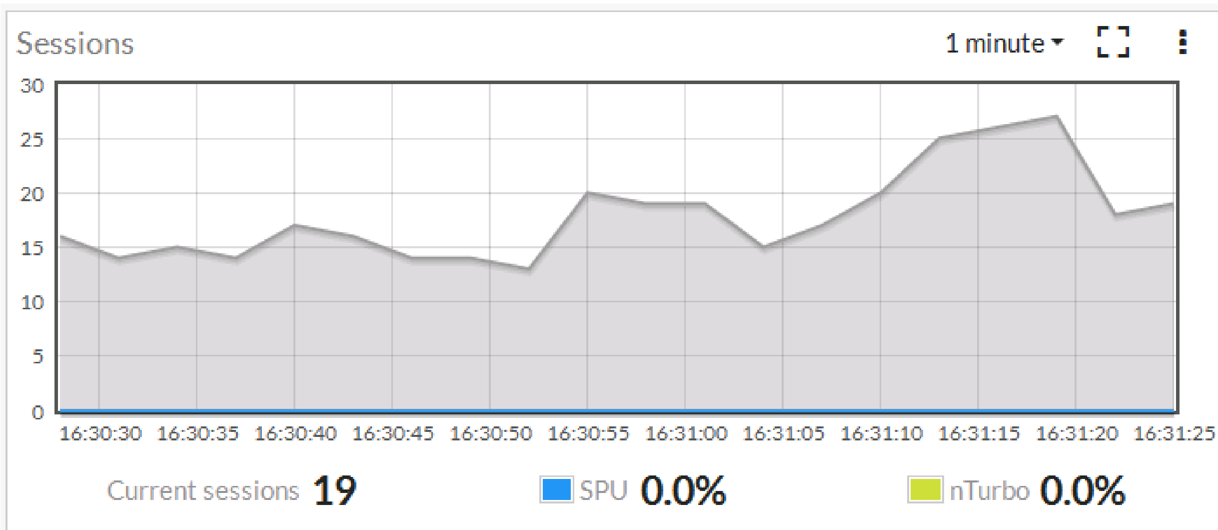
`arp-max` applies shaping based on the maximum number of ARP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 1,000,000 pps.

l2-others-max applies shaping based on the maximum number of other layer 2 packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.

Improved visibility of SPU and nTurbo hardware acceleration (389711)

All hardware acceleration hardware has been renamed Security Processing Units (SPUs). This includes NPx and CPx processors.

SPU and nTurbo data is now visible in a number of places on the GUI. For example, the Active Sessions column pop-up in the firewall policy list and the Sessions dashboard widget:



You can also add SPU filters to many FortiView pages.

NP4Lite option to disable offloading ICMP traffic in IPsec tunnels (383939)

In some cases ICMP traffic in IPsec VPN tunnels may be dropped by the NP4Lite processor due to a bug with the NP4Lite firmware. You can use the following command to avoid this problem by preventing the NP4Lite processor from offloading ICMP sessions in IPsec VPN tunnels. This command is only available on FortiGate models with NP4Lite processors, such as the FortiGate/FortiWiFi-60D.

```
config system npu
   set process-icmp-by-host {disable | enable}
end
```

The option is disabled by default an all ICMP traffic in IPsec VPN tunnels is offloaded where possible. If you are noticing that ICMP packets in IPsec VPN tunnels are being dropped you can disable this option and have all ICMP traffic processed by the CPU and not offloaded to the NP4Lite.

NP6 IPv4 invalid checksum anomaly checking (387675)

The following new options have been added to NP6 processors to check for IPv4 checksum errors in IPv4, TCP, UDP, and ICMP packets.

```
config system np6
   edit {np6_0 | np6_1| ...}
```

```
config fp-anomaly
   set ipv4-csum-err {drop | trap-to-host}
   set tcp-csum-err {drop | trap-to-host}
   set udp-csum-err {drop | trap-to-host}
   set icmp-csum-err {drop | trap-to-host}
end
```

You can use the new options to either drop packets with checksum errors (the default) or send them to the CPU for processing. Normally you would want to drop these packets.

As well, note that when configuring NP6 anomaly protection, the separate options `config fp-anomaly-v4` and `config fp-anomaly-v6` have been combined under `config fp-anomaly`.

Stripping clear text padding and IPsec session ESP padding (416950)

In some situations, when clear text or ESP packets in IPsec sessions may have large amounts of layer 2 padding, the NP6 IPsec engine may not be able to process them and the session may be blocked.

If you notice dropped IPsec sessions, you could try using the following CLI options to cause the NP6 processor to strip clear text padding and ESP padding before sending the packets to the IPsec engine. With padding stripped, the session can be processed normally by the IPsec engine.

Use the following command to strip ESP padding:

```
config system npu
   set strip-esp-padding enable
   set strip-clear-text-padding enable
end
```

Stripping clear text and ESP padding are both disabled by default.

Optionally disable NP6 offloading of traffic passing between 10Gbps and 1Gbps interfaces (392436)

Due to NP6 internal packet buffer limitations, some offloaded packets received at a 10Gbps interface and destined for a 1Gbps interface can be dropped, reducing performance for TCP and IP tunnel traffic. If you experience this performance reduction, you can use the following command to disable offloading sessions passing from 10Gbps interfaces to 1Gbps interfaces:

```
config system npu
   set host-shortcut-mode host-shortcut
end
```

Select `host-shortcut` to stop offloading TCP and IP tunnel packets passing from 10Gbps interfaces to 1Gbps interfaces. TCP and IP tunnel packets passing from 1Gbps interfaces to 10Gbps interfaces are still offloaded as normal.

If `host-shortcut` is set to the default `bi-directional` setting, packets in both directions are offloaded.

Hardware acceleration overview

Most FortiGate models have specialized acceleration hardware, (called Security Processing Units (SPUs)) that can offload resource intensive processing from main processing (CPU) resources. Most FortiGate units include specialized content processors (CPs) that accelerate a wide range of important security processes such as virus scanning, attack detection, encryption and decryption. (Only selected entry-level FortiGate models do not include a CP processor.) Many FortiGate models also contain security processors (SPs) that accelerate processing for specific security features such as IPS and network processors (NPs) that offload processing of high volume network traffic.

Content processors (CP4, CP5, CP6, CP8, and CP9)

Most FortiGate models contain FortiASIC Content Processors (CPs) that accelerate many common resource intensive security related processes. CPs work at the system level with tasks being offloaded to them as determined by the main CPU. Capabilities of the CPs vary by model. Newer FortiGate units include CP8 and CP9 processors. Older CP versions still in use in currently operating FortiGate models include the CP4, CP5, and CP6.

CP9 capabilities

The CP9 content processor provides the following services:

- Flow-based inspection (IPS, application control etc.) pattern matching acceleration with over 10Gbps throughput
  - IPS pre-scan
  - IPS signature correlation
  - Full match processors
- High performance VPN bulk data engine
  - IPsec and SSL/TLS protocol processor
  - DES/3DES/AES128/192/256 in accordance with FIPS46-3/FIPS81/FIPS197
  - MD5/SHA-1/SHA256/384/512-96/128/192/256 with RFC1321 and FIPS180
  - HMAC in accordance with RFC2104/2403/2404 and FIPS198
  - ESN mode
  - GCM support for NSA "Suite B" (RFC6379/RFC6460) including GCM-128/256; GMAC-128/256
- Key Exchange Processor that supports high performance IKE and RSA computation
  - Public key exponentiation engine with hardware CRT support
  - Primary checking for RSA key generation
  - Handshake accelerator with automatic key material generation
  - True Random Number generator
  - Elliptic Curve support for NSA "Suite B"
  - Sub public key engine (PKCE) to support up to 4096 bit operation directly (4k for DH and 8k for RSA with CRT)
- DLP fingerprint support
  - TTTD (Two-Thresholds-Two-Divisors) content chunking
  - Two thresholds and two divisors are configurable

CP8 capabilities

The CP8 content processor provides the following services:

- Flow-based inspection (IPS, application control etc.) pattern matching acceleration
- High performance VPN bulk data engine
  - IPsec and SSL/TLS protocol processor
  - DES/3DES/AES in accordance with FIPS46-3/FIPS81/FIPS197
  - ARC4 in compliance with RC4
  - MD5/SHA-1/SHA256 with RFC1321 and FIPS180
  - HMAC in accordance with RFC2104/2403/2404 and FIPS198
- Key Exchange Processor support high performance IKE and RSA computation
  - Public key exponentiation engine with hardware CRT support
  - Primarily checking for RSA key generation
  - Handshake accelerator with automatic key material generation
  - Random Number generator compliance with ANSI X9.31
  - Sub public key engine (PKCE) to support up to 4096 bit operation directly
- Message authentication module offers high performance cryptographic engine for calculating SHA256/SHA1/MD5 of data up to 4G bytes (used by many applications)
- PCI express Gen 2 four lanes interface
- Cascade Interface for chip expansion

CP6 capabilities

- Dual content processors
- FIPS-compliant DES/3DES/AES encryption and decryption
- SHA-1 and MD5 HMAC with RFC1321 and FIPS180
- HMAC in accordance with RFC2104/2403/2404 and FIPS198
- IPsec protocol processor
- High performance IPsec engine
- Random Number generator compliance with ANSI X9.31
- Key exchange processor for high performance IKE and RSA computation
- Script Processor
- SSL/TLS protocol processor for SSL content scanning and SSL acceleration

CP5 capabilities

- FIPS-compliant DES/3DES/AES encryption and decryption
- SHA-1 and MD5 HMAC with RFC1321/2104/2403/2404 and FIPS180/FIPS198
- IPsec protocol processor
- High performance IPSEC Engine
- Random Number generator compliant with ANSI X9.31
- Public Key Crypto Engine supports high performance IKE and RSA computation
- Script Processor

CP4 capabilities

- FIPS-compliant DES/3DES/AES encryption and decryption
- SHA-1 and MD5 HMAC
- IPSEC protocol processor
- Random Number generator
- Public Key Crypto Engine
- Content processing engine
- ANSI X9.31 and PKCS#1 certificate support

Determining the content processor in your FortiGate unit

Use the `get hardware status` CLI command to determine which content processor your FortiGate unit contains. The output looks like this:

```
get hardware status
Model name: FortiGate-100D
ASIC version: CP8
ASIC SRAM: 64M
CPU: Intel(R) Atom(TM) CPU D525 @ 1.80GHz
Number of CPUs: 4
RAM: 1977 MB
Compact Flash: 15331 MB /dev/sda
Hard disk: 15272 MB /dev/sda
USB Flash: not available
Network Card chipset: Intel(R) PRO/1000 Network Connection (rev.0000)
Network Card chipset: bcm-sw Ethernet driver 1.0 (rev.)
```

The ASIC version line lists the content processor model number.

Viewing SSL acceleration status

You can view the status of SSL acceleration using the following command:

```
get vpn status ssl hw-acceleration-status
Acceleration hardware detected: kxp=on cipher=on
```

Where kxp means key exchange acceleration.

Disabling CP offloading for firewall policies

If you want to completely disable offloading to CP processors for test purposes or other reasons, you can do so in security policies. Here are some examples:

For IPv4 security policies.

```
config firewall policy
   edit 1
      set auto-asic-offload disable
   end
```

For IPv6 security policies.

```
config firewall policy6
   edit 1
      set auto-asic-offload disable
```

```
    end
```

For multicast security policies.

```
config firewall multicast-policy
  edit 1
    set auto-asic-offload disable
  end
```

Disabling `auto-asic-offload` also disables NP offloading.

Security processors (SPs)

FortiGate Security Processing (SP) modules, such as the SP3 but also including the XLP, XG2, XE2, FE8, and CE4, work at both the interface and system level to increase overall system performance by accelerating specialized security processing. You can configure the SP to favor IPS over firewall processing in hostile high-traffic environments.

SP processors include their own IPS engine which is similar to the FortiOS IPS engine but with the following limitations:

- The SP IPS engine does not support SSL deep inspection. When you have SSL deep inspection enabled for a security policy that includes flow-based inspection or IPS, offloading to the SP is disabled and traffic is processed by the FortiGate CPU and CP processors.
- The SP IPS engine does not support FortiGuard Web Filtering. When you enable flow-based FortiGuard Web Filtering on a FortiGate unit with an SP processor, the SP processor cannot perform FortiGuard lookups and web pages fail to load.

The following security processors are available:

- The SP3 (XLP) is built into the FortiGate-5101B and provides IPS acceleration. No special configuration is required. All IPS processing, including traffic accepted by IPv4 and IPv6 traffic policies and IPv4 and IPv6 DoS policies is accelerated by the built-in SP3 processors.
- The FMC-XG2 is an FMC module with two 10Gb/s SPF+ interfaces that can be used on FortiGate-3950B and FortiGate-3951B units.
- The FortiGate-3140B also contains a built-in XG2 using ports 19 and 20.
- The ADM-XE2 is a dual-width AMC module with two 10Gb/s interfaces that can be used on FortiGate-3810A and FortiGate-5001A-DW systems.
- The ADM-FE8 is a dual-width AMC module with eight 1Gb/s interfaces that can be used with the FortiGate-3810A.
- The ASM-CE4 is a single-width AMC module with four 10/100/1000 Mb/s interfaces that can be used on FortiGate-3016B and FortiGate-3810A units.

Traffic is blocked if you enable IPS for traffic passing over inter-VDOM links if that traffic is being offloaded by an SP processor. If you disable SP offloading, traffic will be allowed to flow. You can disable offloading in individual firewall policies by disabling `auto-asic-offload` for those policies. You can also use the following command to disable all IPS offloading:

```
config ips global
   set np-accel-mode none
   set cp-accel-mode none
end
```

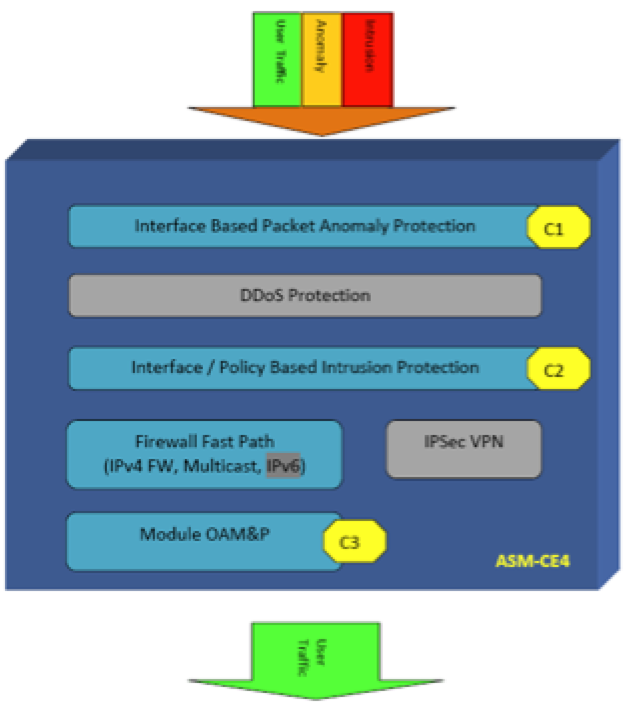
SP Processing Flow

SP processors provide an integrated high performance fast path multilayer solution for both intrusion protection and firewall functions. The multilayered protection starts from anomaly checking at packet level to ensure each packet is sound and reasonable. Immediately after that, a sophisticated set of interface based packet anomaly protection, DDoS protection, policy based intrusion protection, firewall fast path, and behavior based methods are employed to prevent DDoS attacks from the rest of system.

Then the packets enter an interface/policy based intrusion protection system,

where each packet is evaluated against a set of signatures. The end result is streams of user packets that are free of anomaly and attacks, entering the fast path system for unicast or multicast fast path forwarding.

SP processing flow



Displaying information about security processing modules

You can display information about installed SP modules using the CLI command

```
diagnose npu spm
```

For example, for the FortiGate-5101C:

```
FG-5101C # diagnose npu spm list
Available SP Modules:

ID Model      Slot     Interface
0 xh0         built-in  port1, port2, port3, port4,
                        base1, base2, fabric1, fabric2
                        eth10, eth11, eth12, eth13
                        eth14, eth15, eth16, eth17
                        eth18, eth19
```

You can also use this command to get more info about SP processing. This example shows how to display details about how the module is processing sessions using the syn proxy.

```
diagnose npu spm dos synproxy <sp_id>
```

This is a partial output of the command:

```
Number of proxied TCP connections :                 0
Number of working proxied TCP connections :         0
Number of retired TCP connections :                 0
Number of valid TCP connections :                   0
Number of attacks, no ACK from client :             0
Number of no SYN-ACK from server :                  0
Number of reset by server (service not supportted): 0
Number of establised session timeout :              0
Client timeout setting :                            3 Seconds
Server timeout setting :                            3 Seconds
```

Network processors (NP1, NP2, NP3, NP4, NP4Lite, NP6 and NP6Lite)

FortiASIC network processors work at the interface level to accelerate traffic by offloading traffic from the main CPU. Current models contain NP4, NP4Lite, NP6, and NP6lite network processors. Older FortiGate models include NP1 network processors (also known as FortiAccel, or FA2) and NP2 network processors.

The traffic that can be offloaded, maximum throughput, and number of network interfaces supported by each varies by processor model:

- NP6 supports offloading of most IPv4 and IPv6 traffic, IPsec VPN encryption, CAPWAP traffic, and multicast traffic. The NP6 has a maximum throughput of 40 Gbps using 4 x 10 Gbps XAUI or Quad Serial Gigabit Media Independent Interface (QSGMII) interfaces or 3 x 10 Gbps and 16 x 1 Gbps XAUI or QSGMII interfaces. For details about the NP6 processor, see NP6 and NP6lite Acceleration on page 29 and for information about FortiGate models with NP6 processors, see FortiGate NP6 architectures on page 50.
- NP6lite is similar to the NP6 but with a lower throughput and some functional limitations (for example, the NP6lite does not offload CAPWAP traffic). The NP6lite has a maximum throughput of 10 Gbps using 2x QSGMII and 2x Reduced gigabit media-independent interface (RGMII) interfaces. For details about the NP6 processor, see NP6Lite processors on page 31 and for information about FortiGate models with NP6 processors, see FortiGate NP6lite architectures on page 100.
- NP4 supports offloading of most IPv4 firewall traffic and IPsec VPN encryption. The NP4 has a capacity of 20 Gbps through 2 x 10 Gbps interfaces. For details about NP4 processors, see NP4 and NP4Lite Acceleration on page 102 and for information about FortiGate models with NP4 processors, see FortiGate NP4 architectures on page 113.

- NP4lite is similar to the NP4 but with a lower throughput (but with about half the performance)and some functional limitations.
- NP2 supports IPv4 firewall and IPsec VPN acceleration. The NP2 has a capacity of 2 Gbps through 2 x 10 Gbps interfaces or 4 x 1 Gbps interfaces.
- NP1 supports IPv4 firewall and IPsec VPN acceleration with 2 Gbps capacity. The NP1 has a capacity of 2 Gbps through 2 x 1 Gbps interfaces.
  - The NP1 does not support frames greater than 1500 bytes. If your network uses jumbo frames, you may need to adjust the MTU (Maximum Transmission Unit) of devices connected to NP1 ports. Maximum frame size for NP2, NP4, and NP6 processors is 9216 bytes.
  - For both NP1 and NP2 network processors, ports attached to a network processor cannot be used for firmware installation by TFTP.

Sessions that require proxy-based security features (for example, virus scanning, IPS, application control and so on) are not fast pathed and must be processed by the CPU. Sessions that require flow-based security features can be offloaded to NP4 or NP6 network processors if the FortiGate supports NTurbo.

Determining the network processors installed on your FortiGate unit

Use either of the following command to list the NP6 processors in your FortiGate unit:

```
get hardware npu np6 port-list
diagnose npu np6 port-list
```

Use either of the following command to list the NP6lite processors in your FortiGate unit:

```
get hardware npu np6lite port-list
diagnose npu np6lite port-list
```

To list other network processors on your FortiGate unit, use the following CLI command.

```
get hardware npu <model> list
```

<model> can be legacy, np1, np2 or np4.

The output lists the interfaces that have the specified processor. For example, for a FortiGate-5001B:

```
get hardware npu np4 list
ID    Model         Slot       Interface
0     On-board                 port1 port2 port3 port4
                               fabric1 base1 npu0-vlink0 npu0-vlink1
1     On-board                 port5 port6 port7 port8
                               fabric2 base2 npu1-vlink0 npu1-vlink1
```

The `npu0-vlink0`, `npu1-vlink1` etc interfaces are used for accelerating inter-VDOM links.

How NP hardware acceleration alters packet flow

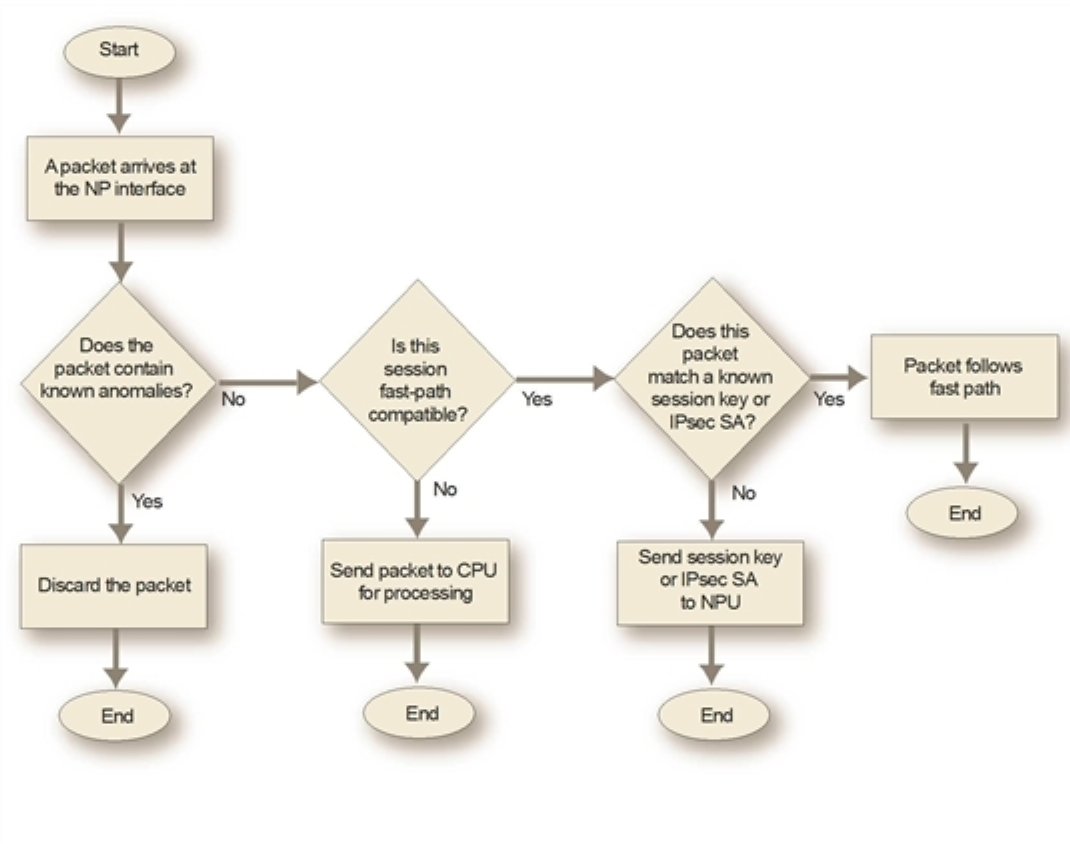
NP hardware acceleration generally alters packet flow as follows:

1. Packets initiating a session pass to the FortiGate unit’s main processing resources (CPU).
2. The FortiGate unit assesses whether the session matches fast path (offload) requirements.
   To be suitable for offloading, traffic must possess only characteristics that can be processed by the fast path. The list of requirements depends on the processor, see NP6 session fast path requirements on page 29 or NP4 session fast path requirements on page 103.

If the session can be fast pathed, the FortiGate unit sends the session key or IPsec security association (SA) and configured firewall processing action to the appropriate network processor.

3. Network processors continuously match packets arriving on their attached ports against the session keys and SAs they have received.
   - If a network processor's network interface is configured to perform hardware accelerated anomaly checks, the network processor drops or accepts packets that match the configured anomaly patterns. These checks are separate from and in advance of anomaly checks performed by IPS, which is not compatible with network processor offloading. See Offloading NP4 anomaly detection on page 110.
   - The network processor next checks for a matching session key or SA. If a matching session key or SA is found, and if the packet meets packet requirements, the network processor processes the packet according to the configured action and then sends the resulting packet. This is the actual offloading step. Performing this processing on the NP processor improves overall performance because the NP processor is optimized for this task. As well, overall FortiGate performance is improved because the CPU has fewer sessions to process.

NP network processor packet flow



- If a matching session key or SA is not found, or if the packet does not meet packet requirements, the packet cannot be offloaded. The network processor sends the data to the FortiGate unit's CPU, which processes the packet.

Encryption and decryption of IPsec traffic originating from the FortiGate can utilize network processor encryption capabilities.

Packet forwarding rates vary by the percentage of offloadable processing and the type of network processing required by your configuration, but are independent of frame size. For optimal traffic types, network throughput can equal wire speed.

NP processors and traffic logging and monitoring

Except for the NP6, network processors do not count offloaded packets, and offloaded packets are not logged by traffic logging and are not included in traffic statistics and traffic log reports.

NP6 processors support per-session traffic and byte counters, Ethernet MIB matching, and reporting through messages resulting in traffic statistics and traffic log reporting.

Accelerated sessions on FortiView All Sessions page

When viewing sessions in the FortiView All Sessions console, NP4/ NP6 accelerated sessions are highlighted with an NP4 or NP6 icon. The tooltip for the icon includes the NP processor type and the total number of accelerated sessions.

You can also configure filtering to display FortiASIC sessions.

NP session offloading in HA active-active configuration

Network processors can improve network performance in active-active (load balancing) high availability (HA) configurations, even though traffic deviates from general offloading patterns, involving more than one network processor, each in a separate FortiGate unit. No additional offloading requirements apply.

Once the primary FortiGate unit's main processing resources send a session key to its network processor(s), network processor(s) on the primary unit can redirect any subsequent session traffic to other cluster members, reducing traffic redirection load on the primary unit's main processing resources.

As subordinate units receive redirected traffic, each network processor in the cluster assesses and processes session offloading independently from the primary unit. Session key states of each network processor are not part of synchronization traffic between HA members.

Configuring NP HMAC check offloading

Hash-based Message Authentication Code (HMAC) checks offloaded to network processors by default. You can enter the following command to disable this feature:

```
configure system global
   set ipsec-hmac-offload disable
end
```

Software switch interfaces and NP processors

FortiOS supports creating a software switch by grouping two or more FortiGate physical interfaces into a single virtual or software switch interface. All of the interfaces in this virtual switch act like interfaces in a hardware switch in that they all have the same IP address and can be connected to the same network. You create a software switch interface from the CLI using the command `config system switch-interface`.

The software switch is a bridge group of several interfaces, and the FortiGate CPU maintains the mac-port table for this bridge. As a result of this CPU involvement, traffic processed by a software switch interface is not offloaded to network processors.

Disabling NP acceleration for individual IPsec VPN phase 1s

Use the following command to disable NP offloading for an interface-based IPsec VPN phase 1:

```
config vpn ipsec phase1-interface
   edit phase-1-name
      set npu-offload disable
end
```

Use the following command to disable NP offloading for a policy-based IPsec VPN phase 1:

```
config vpn ipsec phase1
   edit phase-1-name
      set npu-offload disable
end
```

The `npu-offload` option is enabled by default.

Disabling NP offloading for unsupported IPsec encryption or authentication algorithms

In general, more recent IPsec VPN encryption and authentication algorithms may not be supported by older NP processors. For example, NP4 network processors do not support SHA-256, SHA-384, and SHA-512. IPsec traffic with unsupported algorithms is not offloaded and instead is processed by the FortiGate CPU. In addition, this configuration may cause packet loss and other performance issues. If you experience packet loss or performance problems you should set the `npu-offload` option to `disable`. Future FortiOS versions should prevent selecting algorithms not supported by the hardware.

Disabling NP offloading for firewall policies

Use the following options to disable NP offloading for specific security policies:

For IPv4 security policies.

```
config firewall policy
   edit 1
      set auto-asic-offload disable
   end
```

For IPv6 security policies.

```
config firewall policy6
   edit 1
      set auto-asic-offload disable
   end
```

For multicast security policies.

```
config firewall multicast-policy
   edit 1
      set auto-asic-offload disable
   end
```

Enabling strict protocol header checking disables all hardware acceleration

You can use the following command to cause the FortiGate to apply strict header checking to verify that a packet is part of a session that should be processed. Strict header checking includes verifying the layer-4 protocol header

length, the IP header length, the IP version, the IP checksum, IP options, and verifying that ESP packets have the correct sequence number, SPI, and data length.If the packet fails header checking it is dropped by the FortiGate unit.

```
config system global
   check-protocol-header strict
end
```

Enabling strict header checking disables all hardware acceleration. This includes NP, SP.and CP processing.

sFlow and NetFlow and hardware acceleration

NP6 offloading is supported when you configure NetFlow for interfaces connected to NP6 processors.

Configuring sFlow on any interface disables all NP4 and NP6 offloading for all traffic on that interface. As well, configuring NetFlow on any interface disables NP4 offloading for all traffic on that interface.

Checking that traffic is offloaded by NP processors

A number of diagnose commands can be used to verify that traffic is being offloaded.

Using the packet sniffer

Use the packet sniffer to verify that traffic is offloaded. Offloaded traffic is not picked up by the packet sniffer so if you are sending traffic through the FortiGate unit and it is not showing up on the packet sniffer you can conclude that it is offloaded.

```
diag sniffer packet port1 <option>
```

If you want the packet sniffer to be able to see offloaded traffic you can temporarily disable offloading the traffic, run the packet sniffer to view it and then re-enable offloading. As an example, you may want to sniff the traffic that is accepted by a specific firewall policy. You can edit the policy and set the `auto-asic-offload` option to `disable` to disable offloading this traffic.You can also disable offloading for IPsec VPN traffic, see Disabling NP acceleration for individual IPsec VPN phase 1s on page 23.

Checking the firewall session offload tag

Use the `diagnose sys session list` command to display sessions. If the output for a session includes the `npu info` field you should see information about session being offloaded. If the output doesn’t contain an `npu info` field then the session has not been offloaded.

```
diagnose sys session list
session info: proto=6 proto_state=01 duration=34 expire=3565 timeout=3600
    flags=00000000 sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/
state=may_dirty npu
```

```
statistic(bytes/packets/allow_err): org=295/3/1 reply=60/1/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=48->6/6->48 gwy=10.1.100.11/11.11.11.1
hook=pre dir=org act=noop 172.16.200.55:56453->10.1.100.11:80(0.0.0.0:0)
hook=post dir=reply act=noop 10.1.100.11:80->172.16.200.55:56453(0.0.0.0:0)
pos/(before,after) 0/(0,0), 0/(0,0)
misc=0 policy_id=1 id_policy_id=0 auth_info=0 chk_client_info=0 vd=4
serial=0000091c tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=172.16.200.55, bps=393
npu_state=00000000
npu info: flag=0x81/0x81, offload=4/4, ips_offload=0/0, epid=1/23, ipid=23/1,
    vlan=32779/0
```

Verifying IPsec VPN traffic offloading

The following commands can be used to verify IPsec VPN traffic offloading to NP processors.

```
diagnose vpn ipsec status
NP1/NP2/NP4_0/sp_0_0:
      null: 0 0
      des: 0 0
       3des: 4075 4074
      aes: 0 0
      aria: 0 0
      seed: 0 0
      null: 0 0
       md5: 4075 4074
      sha1: 0 0
      sha256: 0 0
      sha384: 0 0
      sha512: 0 0

diagnose vpn tunnel list
list all ipsec tunnel in vd 3
------------------------------------------------------
name=p1-vdom1 ver=1 serial=5 11.11.11.1:0->11.11.11.2:0 lgwy=static tun=tunnel
    mode=auto bound_if=47
proxyid_num=1 child_num=0 refcnt=8 ilast=2 olast=2
stat: rxp=3076 txp=1667 rxb=4299623276 txb=66323
dpd: mode=active on=1 idle=5000ms retry=3 count=0 seqno=20
natt: mode=none draft=0 interval=0 remote_port=0
proxyid=p2-vdom1 proto=0 sa=1 ref=2 auto_negotiate=0 serial=1
src: 0:0.0.0.0/0.0.0.0:0
dst: 0:0.0.0.0/0.0.0.0:0
SA: ref=6 options=0000000e type=00 soft=0 mtu=1436 expire=1736 replaywin=2048 seqno=680
life: type=01 bytes=0/0 timeout=1748/1800
dec: spi=ae01010c esp=3des key=24 18e021bcace225347459189f292fbc2e4677563b07498a07
ah=md5 key=16 b4f44368741632b4e33e5f5b794253d3
enc: spi=ae01010d esp=3des key=24 42c94a8a2f72a44f9a3777f8e6aa3b24160b8af15f54a573
ah=md5 key=16 6214155f76b63a93345dcc9ec02d6415
dec:pkts/bytes=3073/4299621477, enc:pkts/bytes=1667/66375
 npu_flag=03 npu_rgwy=11.11.11.2 npu_lgwy=11.11.11.1 npu_selid=4

diagnose sys session list
session info: proto=6 proto_state=01 duration=34 expire=3565 timeout=3600
    flags=00000000 sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
```

```
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/p1-vdom2
state=re may_dirty npu
statistic(bytes/packets/allow_err): org=112/2/1 reply=112/2/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=57->7/7->57 gwy=10.1.100.11/11.11.11.1
hook=pre dir=org act=noop 172.16.200.55:35254->10.1.100.11:80(0.0.0.0:0)
hook=post dir=reply act=noop 10.1.100.11:80->172.16.200.55:35254(0.0.0.0:0)
pos/(before,after) 0/(0,0), 0/(0,0)
misc=0 policy_id=1 id_policy_id=0 auth_info=0 chk_client_info=0 vd=4
serial=00002d29 tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=172.16.200.55, bps=260
npu_state=00000000
npu info: flag=0x81/0x82, offload=7/7, ips_offload=0/0, epid=1/3, ipid=3/1,
    vlan=32779/0
```

Dedicated Management CPU

The web-based manager and CLI of FortiGate units with NP6 and NP4 processors may become unresponsive when the system is under heavy processing load because NP6 or NP4 interrupts overload the CPUs preventing CPU cycles from being used for management tasks. You can resolve this issue by using the following command to dedicate CPU core 0 to management tasks.

```
config system npu
   set dedicated-management-cpu {enable | disable}
end
```

All management tasks are then processed by CPU 0 and NP6 or NP4 interrupts are handled by the remaining CPU cores.

Offloading flow-based content inspection with NTurbo and IPSA

You can use the following command to configure NTurbo and IPA Advanced (IPSA) offloading and acceleration of firewall sessions that have flow-based security profiles. This includes firewall sessions with IPS, application control, CASI, flow-based antivirus and flow-based web filtering.

```
config ips global
   set np-accel-mode {none | basic}
   set cp-accel-mode {none | basic | advanced}
end
```

NTurbo offloads firewall sessions with flow-based security profiles to NPx processors

NTurbo offloads firewall sessions that include flow-based security profiles to NP4 or NP6 network processors. Without NTurbo, or with NTurbo disabled, all firewall sessions that include flow-based security profiles are processed by the FortiGate CPU.

NTurbo can only offload firewall sessions containing flow-based security profiles if the session could otherwise have been offloaded except for the presence of the flow-based security profiles. If something else prevents the session from being offloaded, NTurbo will not offload that session.

Firewall sessions that include proxy-based security profiles are never offloaded to network processors and are always processed by the FortiGate CPU.

NTurbo creates a special data path to redirect traffic from the ingress interface to IPS, and from IPS to the egress interface. NTurbo allows firewall operations to be offloaded along this path, and still allows IPS to behave as a stage in the processing pipeline, reducing the workload on the FortiGate CPU and improving overall throughput.

NTurbo sessions still offload pattern matching and other processes to CP processors, just like normal flow-based sessions.

If NTurbo is supported by your FortiGate unit, you can use the following command to configure it:

```
config ips global
   set np-accel-mode {basic | none}
end
```

`basic` enables NTurbo and is the default setting for FortiGate models that support NTurbo. `none` disables NTurbo. If the `np-accel-mode` option is not available, then your FortiGate does not support NTurbo.

There are some special cases where sessions may not be offloaded by NTurbo, even when NTurbo is explicitly enabled. In these cases the sessions are handled by the FortiGate CPU.

- NP acceleration is disabled. For example, `auto-asic-offload` is disabled in the firewall policy configuration.
- The firewall policy includes proxy-based security profiles.
- The sessions require FortiOS session-helpers. For example, FTP sessions can not be offloaded to NP processors because FTP sessions use the FTP session helper.
- Interface policies or DoS policies have been added to the ingress or egress interface.
- Tunneling is enabled. Any traffic to or from a tunneled interface (IPSec, IPinIP, SSL VPN, GRE, CAPWAP, etc.) cannot be offloaded by NTurbo.

IPSA offloads flow-based advanced pattern matching to CPx processors

IPSA offloads advanced or enhanced pattern matching operations required for flow-based content processing to CP8 and CP9 Content Processors. IPSA offloads enhanced pattern matching for NTurbo firewall sessions and firewall sessions that are not offloaded to NP processors. When IPSA is turned on, flow-based pattern databases are compiled and downloaded to the content processors from the IPS engine and IPS database. Flow-based pattern matching requests are redirected to the CP hardware reducing the load on the FortiGate CPU and accelerating pattern matching.

IF IPSA is supported on your FortiGate unit, you can use the following command to configure it:

```
config ips global
   set cp-accel-mode {advanced | basic | none}
end
```

`basic` offloads basic pattern matching. `advanced` offloads more types of pattern matching resulting in higher throughput than basic mode. `advanced` is only available on FortiGate models with two or more CP8s or one or more CP9s. If the `cp-accel-mode` option is not available, then your FortiGate does not support IPSA.

On FortiGates with one CP8, the default `cp-accel-mode` is `basic`. Setting the mode to `advanced` does not change the types of pattern matching that are offloaded.

On FortiGates with two or more CP8s or one or more CP9s the default `cp-accel-mode` is `advanced`. You can set the mode to `basic` to offload fewer types of pattern matching.

Preventing packet ordering problems with NP4, NP6 and NP6lite FortiGates under heavy load

In some cases when FortiGate units with NP4, NP6, or NP6lite processors are under heavy load the packets used in the TCP 3-way handshake of some sessions may be transmitted by the FortiGate in the wrong order resulting in the TCP sessions failing.

If you notice TCP sessions failing when a FortiGate with NP4, NP6, or NP6lite processors is very busy you can enable `delay-tcp-npu-session` in the firewall policy receiving the traffic. This option resolves the problem by delaying the session to make sure that there is time for all of the handshake packets to reach the destination before the session begins transmitting data.

```
config firewall policy
   set delay-tcp-npu-session enable
end
```

NP6 and NP6lite Acceleration

NP6 and NP6lite network processors provide fastpath acceleration by offloading communication sessions from the FortiGate CPU. When the first packet of a new session is received by an interface connected to an NP6 processor, just like any session connecting with any FortiGate interface, the session is forwarded to the FortiGate CPU where it is matched with a security policy. If the session is accepted by a security policy and if the session can be offloaded its session key is copied to the NP6 processor that received the packet. All of the rest of the packets in the session are intercepted by the NP6 processor and fast-pathed out of the FortiGate unit to their destination without ever passing through the FortiGate CPU. The result is enhanced network performance provided by the NP6 processor plus the network processing load is removed from the CPU. In addition the NP6 processor can handle some CPU intensive tasks, like IPsec VPN encryption/decryption.

NP6lite processors have the same architecture and function in the same way as NP6 processors. See NP6Lite processors on page 31. All of the descriptions of NP6 processors in this document can be applied to NP6lite possessors except where noted.

Session keys (and IPsec SA keys) are stored in the memory of the NP6 processor that is connected to the interface that received the packet that started the session. All sessions are fast-pathed and accelerated, even if they exit the FortiGate unit through an interface connected to another NP6. There is no dependence on getting the right pair of interfaces since the offloading is done by the receiving NP6.

The key to making this possible is an Integrated Switch Fabric (ISF) that connects the NP6s and the FortiGate unit interfaces together. Many FortiGate units with NP6 processors also have an ISF. The ISF allows any port connectivity. All ports and NP6s can communicate with each other over the ISF. There are no special ingress and egress fast path requirements as long as traffic enters and exits on interfaces connected to the same ISF.

Some FortiGate units, such as the FortiGate-1000D include multiple NP6 processors that are not connected by an ISF. Because the ISF is not present fast path acceleration is supported only between interfaces connected to the same NP6 processor. Since the ISF introduces some latency, models with no ISF provide low-latency network acceleration between network interfaces connected to the same NP6 processor.

Each NP6 has a maximum throughput of 40 Gbps using 4 x 10 Gbps XAUI or Quad Serial Gigabit Media Independent Interface (QSGMII) interfaces or 3 x 10 Gbps and 16 x 1 Gbps XAUI or QSGMII interfaces.

There are at least two limitations to keep in mind:

- The capacity of each NP6 processor. An individual NP6 processor can support between 10 and 16 million sessions. This number is limited by the amount of memory the processor has. Once an NP6 processor hits its session limit, sessions that are over the limit are sent to the CPU. You can avoid this problem by as much as possible distributing incoming sessions evenly among the NP6 processors. To be able to do this you need to be aware of which interfaces connect to which NP6 processors and distribute incoming traffic accordingly.
- The NP6 processors in some FortiGate units employ NP direct technology that removes the ISF. The result is very low latency but no inter-processor connectivity requiring you to make sure that traffic to be offloaded enters and exits the FortiGate through interfaces connected to the same NP processor.

NP6 session fast path requirements

NP6 processors can offload the following traffic and services:

- IPv4 and IPv6 traffic and NAT64 and NAT46 traffic (as well as IPv4 and IPv6 versions of the following traffic types where appropriate).
- Link aggregation (LAG) (IEEE 802.3ad) traffic and traffic from static redundant interfaces (see Increasing NP6 offloading capacity using link aggregation groups (LAGs) on page 35).
- TCP, UDP, ICMP and SCTP traffic.
- IPsec VPN traffic, and offloading of IPsec encryption/decryption (including SHA2-256 and SHA2-512)
- IPsec traffic that passes through a FortiGate without being unencrypted.
- Anomaly-based intrusion prevention, checksum offload and packet defragmentation .
- IPIP tunneling (also called IP in IP tunneling), SIT tunneling, and IPv6 tunneling sessions.
- Multicast traffic (including Multicast over IPsec).
- CAPWAP and wireless bridge traffic tunnel encapsulation to enable line rate wireless forwarding from FortiAP devices (not supported by the NP6lite).
- Traffic shaping and priority queuing for both shared and per IP traffic shaping.
- Syn proxying (not supported by the NP6lite).
- DNS session helper (not supported by the NP6lite).
- Inter-VDOM link traffic.

Sessions that are offloaded must be fast path ready. For a session to be fast path ready it must meet the following criteria:

- Layer 2 type/length must be 0x0800 for IPv4 or 0x86dd for IPv6 (IEEE 802.1q VLAN specification is supported)
- Layer 3 protocol can be IPv4 or IPv6
- Layer 4 protocol can be UDP, TCP, ICMP, or SCTP
- In most cases, Layer 3 / Layer 4 header or content modification sessions that require a session helper can be offloaded.
- Local host traffic (originated by the FortiGate unit) can be offloaded
- If the FortiGate supports, NTurbo sessions can be offloaded if they are accepted by firewall policies that include IPS, Application Control, CASI, flow-based antivirus, or flow-based web filtering.

Offloading Application layer content modification is not supported. This means that sessions are not offloaded if they are accepted by firewall policies that include proxy-based virus scanning, proxy-based web filtering, DNS filtering, DLP, Anti-Spam, VoIP, ICAP, Web Application Firewall, or Proxy options.

If you disable anomaly checks by Intrusion Prevention (IPS), you can still enable hardware accelerated anomaly checks using the `fp-anomaly` field of the `config system interface` CLI command. See Configuring individual NP6 processors on page 39.

If a session is not fast path ready, the FortiGate unit will not send the session key or IPsec SA key to the NP6 processor. Without the session key, all session key lookup by a network processor for incoming packets of that session fails, causing all session packets to be sent to the FortiGate unit's main processing resources, and processed at normal speeds.

If a session is fast path ready, the FortiGate unit will send the session key or IPsec SA key to the network processor. Session key or IPsec SA key lookups then succeed for subsequent packets from the known session or IPsec SA.

Packet fast path requirements

Packets within the session must then also meet packet requirements.

- Incoming packets must not be fragmented.
- Outgoing packets must not require fragmentation to a size less than 385 bytes. Because of this requirement, the configured MTU (Maximum Transmission Unit) for a network processor's network interfaces must also meet or exceed the network processors' supported minimum MTU of 385 bytes.

Mixing fast path and non-fast path traffic

If packet requirements are not met, an individual packet will be processed by the FortiGate CPU regardless of whether other packets in the session are offloaded to the NP6.

Also, in some cases, a protocol's session(s) may receive a mixture of offloaded and non-offloaded processing. For example, VoIP control packets may not be offloaded but VoIP data packets (voice packets) may be offloaded.

NP6Lite processors

The NP6Lite works the same way as the NP6. Being a lighter version, the NP6Lite has a lower capacity than the NP6. The NP6lite max throughput is 10 Gbps using 2x QSGMII and 2x Reduced gigabit media-independent interface (RGMII) interfaces.

Also, the NP6lite does not offload the following types of sessions:

- CAPWAP
- Syn proxy
- DNS session helper

NP6 and NP6Lite processors and sFlow and NetFlow

NP6 and NP6Lite offloading is supported when you configure NetFlow for interfaces connected to NP6 or NP6Lite processors. Offloading of other sessions is not affected by configuring NetFlow.

Configuring sFlow on any interface disables all NP6 and NP6Lite offloading for all traffic on that interface.

NP6 processors and traffic shaping

NP6-offloaded sessions support most types of traffic shaping. However, in bandwidth and out bandwidth traffic shaping, set using the following command, is not supported:

```
config system interface
   edit port1
      set outbandwidth <value>
      set inbandwidth <value>
   end
```

Configuring in bandwidth traffic shaping has no effect. Configuring out bandwidth traffic shaping imposes more limiting than configured, potentially reducing throughput more than expected.

NP Direct

On FortiGates with more than one NP6 processor, removing the Internal Switch Fabric (ISF) for NP Direct architecture provides direct access to the NP6 processors for the lowest latency forwarding. Because the NP6 processors are not connected, care must be taken with network design to make sure that all traffic to be offloaded enters and exits the FortiGate through interfaces connected to the same NP6 processor. As well Link Aggregation (LAG) interfaces should only include interfaces all connected to the same NP6 processor.

Example NP direct hardware with more than one NP6 processor includes:

- Ports 25 to 32 of the FortiGate-3700D in low latency mode.
- FortiGate-2000E
- FortiGate-2500E

Viewing your FortiGate NP6 processor configuration

Use either of the following commands to view the NP6 processor hardware configuration of your FortiGate unit:

```
get hardware npu np6 port-list
diagnose npu np6 port-list
```

If your FortiGate has NP6lite processors, you can use either of the following commands:

```
get hardware npu np6lite port-list
diagnose npu np6lite port-list
```

For example, for the FortiGate-5001D the output would be:

```
get hardware npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6_0  0    port3            10G   Yes
       1
       2    base1            1G    Yes
       3
       0-3  port1            40G   Yes
       0-3  fabric1          40G   Yes
       0-3  fabric3          40G   Yes
       0-3  fabric5          40G   Yes
------ ---- -------          ----- ----------
np6_1  0
       1    port4            10G   Yes
       2
       3    base2            1G    Yes
       0-3  port2            40G   Yes
       0-3  fabric2          40G   Yes
       0-3  fabric4          40G   Yes
------ ---- -------          ----- ----------
```

For more example output for different FortiGate models, see FortiGate NP6 architectures on page 50 and FortiGate NP6lite architectures on page 100.

You can also use the following command to view the offloading features enabled or disabled on each of the NP6 processors in your FortiGate unit:

```
diagnose npu npu-feature
                    np_0      np_1
------------------- --------- ---------
Fastpath            Enabled   Enabled
Low-latency-mode    Disabled  Disabled
Low-latency-cap     No        No
IPv4 firewall       Yes       Yes
IPv6 firewall       Yes       Yes
IPv4 IPSec          Yes       Yes
IPv6 IPSec          Yes       Yes
IPv4 tunnel         Yes       Yes
IPv6 tunnel         Yes       Yes
GRE tunnel          No        No
IPv4 Multicast      Yes       Yes
IPv6 Multicast      Yes       Yes
CAPWAP              Yes       Yes
```

Optimizing NP6 performance by distributing traffic to XAUI links

On most FortiGate units with NP6 processors, the FortiGate interfaces are switch ports that connect to the NP6 processors with XAUI links. Packets pass from the interfaces to the NP6 processor over the XAUI links. Each NP6 processor has a 40 Gigabit bandwidth capacity. The four XAUI links each have a 10 Gigabit capacity for a total of 40 Gigabits.

On many FortiGate units with NP6 processors, the NP6 processors and the XAUI links are over-subscribed. Since the NP6 processors are connected by an Integrated Switch Fabric, you do not have control over how traffic is distributed to them. In fact traffic is distributed evenly by the ISF.

However, you can control how traffic is distributed to the XAUI links and you can optimize performance by distributing traffic evenly among the XAUI links. For example, if you have a very high amount of traffic passing between two networks, you can connect each network to interfaces connected to different XAUI links to distribute the traffic for each network to a different XAUI link.

For example, on a FortiGate-3200D (See FortiGate-3200D fast path architecture on page 74), there are 48 10-Gigabit interfaces that send and receive traffic for two NP6 processors over a total of eight 10-Gigabit XAUI links. Each XAUI link gets traffic from six 10-Gigabit FortiGate interfaces. The amount of traffic that the FortiGate-3200D can offload is limited by the number of NP6 processors and the number of XAUI links. You can optimize the amount of traffic that the FortiGate-3200D can process by distributing it evenly amount the XAUI links and the NP6 processors.

You can see the Ethernet interface, XAUI link, and NP6 configuration by entering the `get hardware npu np6 port-list` command. For the FortiGate-3200D the output is:

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
```

```
np6_0  0    port1   10G   Yes
       0    port5   10G   Yes
       0    port10  10G   Yes
       0    port13  10G   Yes
       0    port17  10G   Yes
       0    port22  10G   Yes
       1    port2   10G   Yes
       1    port6   10G   Yes
       1    port9   10G   Yes
       1    port14  10G   Yes
       1    port18  10G   Yes
       1    port21  10G   Yes
       2    port3   10G   Yes
       2    port7   10G   Yes
       2    port12  10G   Yes
       2    port15  10G   Yes
       2    port19  10G   Yes
       2    port24  10G   Yes
       3    port4   10G   Yes
       3    port8   10G   Yes
       3    port11  10G   Yes
       3    port16  10G   Yes
       3    port20  10G   Yes
       3    port23  10G   Yes
------ ---- ------- ----- ----------
np6_1  0    port26  10G   Yes
       0    port29  10G   Yes
       0    port33  10G   Yes
       0    port37  10G   Yes
       0    port41  10G   Yes
       0    port45  10G   Yes
       1    port25  10G   Yes
       1    port30  10G   Yes
       1    port34  10G   Yes
       1    port38  10G   Yes
       1    port42  10G   Yes
       1    port46  10G   Yes
       2    port28  10G   Yes
       2    port31  10G   Yes
       2    port35  10G   Yes
       2    port39  10G   Yes
       2    port43  10G   Yes
       2    port47  10G   Yes
       3    port27  10G   Yes
       3    port32  10G   Yes
       3    port36  10G   Yes
       3    port40  10G   Yes
       3    port44  10G   Yes
       3    port48  10G   Yes
------ ---- ------- ----- ----------
```

In this command output you can see that each NP6 has for four XAUI links (0 to 3) and that each XAUI link is connected to six 10-gigabit Ethernet interfaces. To optimize throughput you should keep the amount of traffic

being processed by each XAUI port to under 10 Gbps. So for example, if you want to offload traffic from four 10-gigabit networks you can connect these networks to Ethernet interfaces 1, 2, 3 and 4. This distributes the traffic from each 10-Gigabit network to a different XAUI link. Also, if you wanted to offload traffic from four more 10-Gigabit networks you could connect them to Ethernet ports 26, 25, 28, and 27. As a result each 10-Gigabit network would be connected to a different XAUI link.

Increasing NP6 offloading capacity using link aggregation groups (LAGs)

NP6 processors can offload sessions received by interfaces in link aggregation groups (LAGs) (IEEE 802.3ad). A 802.3ad Link Aggregation and it's management protocol, Link Aggregation Control Protocol (LACP) LAG combines more than one physical interface into a group that functions like a single interface with a higher capacity than a single physical interface. For example, you could use a LAG if you want to offload sessions on a 30 Gbps link by adding three 10-Gbps interfaces to the same LAG.

All offloaded traffic types are supported by LAGs, including IPsec VPN traffic. Just like with normal interfaces, traffic accepted by a LAG is offloaded by the NP6 processor connected to the interfaces in the LAG that receive the traffic to be offloaded. If all interfaces in a LAG are connected to the same NP6 processor, traffic received by that LAG is offloaded by that NP6 processor. The amount of traffic that can be offloaded is limited by the capacity of the NP6 processor.

If a FortiGate has two or more NP6 processors connected by an integrated switch fabric (ISF), you can use LAGs to increase offloading by sharing the traffic load across multiple NP6 processors. You do this by adding physical interfaces connected to different NP6 processors to the same LAG.

Adding a second NP6 processor to a LAG effectively doubles the offloading capacity of the LAG. Adding a third further increases offloading. The actual increase in offloading capacity may not actually be doubled by adding a second NP6 or tripled by adding a thrid. Traffic and load conditions and other factors may limit the actual offloading result.

The increase in offloading capacity offered by LAGs and multiple NP6s is supported by the integrated switch fabric (ISF) that allows multiple NP6 processors to share session information. Most FortiGate units with multiple NP6 processors also have an ISF. However, FortiGate modules such as the 1000D, 2000E, and 2500E do not have an ISF. If you attempt to add interfaces connected to different NP6 processors to a LAG the system displays an error message.

There are also a few limitations to LAG NP6 offloading support for IPsec VPN:

- IPsec VPN anti-replay protection cannot be used if IPSec is configured on a LAG that has interfaces connected to multiple NP6 processors.
- Because the encrypted traffic for one IPsec VPN tunnel has the same 5-tuple, the traffic from one tunnel can only can be balanced to one interface in a LAG. This limits the maximum throughput for one IPsec VPN tunnel in an NP6 LAG group to 10Gbps.

NP6 processors and redundant interfaces

NP6 processors can offload sessions received by interfaces that are part of a redundant interface. You can combine two or more physical interfaces into a redundant interface to provide link redundancy. Redundant interfaces ensure connectivity if one physical interface, or the equipment on that interface, fails. In a redundant

interface, traffic travels only over one interface at a time. This differs from an aggregated interface where traffic travels over all interfaces for distribution of increased bandwidth.

All offloaded traffic types are supported by redundant interfaces, including IPsec VPN traffic. Just like with normal interfaces, traffic accepted by a redundant interface is offloaded by the NP6 processor connected to the interfaces in the redundant interface that receive the traffic to be offloaded. If all interfaces in a redundant interface are connected to the same NP6 processor, traffic received by that redundant interface is offloaded by that NP6 processor. The amount of traffic that can be offloaded is limited by the capacity of the NP6 processor.

If a FortiGate has two or more NP6 processors connected by an integrated switch fabric (ISF), you can create redundant interfaces that include physical interfaces connected to different NP6 processors. However, with a redundant interface, only one of the physical interfaces is processing traffic at any given time. So you cannot use redundant interfaces to increase performance in the same way as you can with aggregate interfaces.

The ability to add redundnat interfaces connected to multiple NP6s is supported by the integrated switch fabric (ISF) that allows multiple NP6 processors to share session information. Most FortiGate units with multiple NP6 processors also have an ISF. However, FortiGate models such as the 1000D, 2000E, and 2500E do not have an ISF. If you attempt to add interfaces connected to different NP6 processors to a redundant interface the system displays an error message.

Configuring Inter-VDOM link acceleration with NP6 processors

FortiGate units with NP6 processors include inter-VDOM links that can be used to accelerate inter-VDOM link traffic.

- For a FortiGate unit with two NP6 processors there are two accelerated inter-VDOM links, each with two interfaces:
  - **npu0_vlink:**
    npu0_vlink0
    npu0_vlink1
  - **npu1_vlink:**
    npu1_vlink0
    npu1_vlink1

These interfaces are visible from the GUI and CLI. For a FortiGate unit with NP6 interfaces, enter the following CLI command to display the NP6-accelerated inter-VDOM links:

```
get system interface
...
== [ npu0_vlink0 ]
name: npu0_vlink0 mode: static ip: 0.0.0.0 0.0.0.0 status: down netbios-forward: disable
    type: physical sflow-sampler: disable explicit-web-proxy: disable explicit-ftp-proxy:
    disable mtu-override: disable wccp: disable drop-overlapped-fragment: disable drop-
    fragment: disable

== [ npu0_vlink1 ]
name: npu0_vlink1 mode: static ip: 0.0.0.0 0.0.0.0 status: down netbios-forward: disable
    type: physical sflow-sampler: disable explicit-web-proxy: disable explicit-ftp-proxy:
    disable mtu-override: disable wccp: disable drop-overlapped-fragment: disable drop-
    fragment: disable

== [ npu1_vlink0 ]
name: npu1_vlink0 mode: static ip: 0.0.0.0 0.0.0.0 status: down netbios-forward: disable
    type: physical sflow-sampler: disable explicit-web-proxy: disable explicit-ftp-proxy:
```

```
    disable mtu-override: disable wccp: disable drop-overlapped-fragment: disable drop-
    fragment: disable

== [ npu1_vlink1 ]
name: npu1_vlink1 mode: static ip: 0.0.0.0 0.0.0.0 status: down netbios-forward: disable
    type: physical sflow-sampler: disable explicit-web-proxy: disable explicit-ftp-proxy:
    disable mtu-override: disable wccp: disable drop-overlapped-fragment: disable drop-
    fragment: disable
...
```

By default the interfaces in each inter-VDOM link are assigned to the root VDOM. To use these interfaces to accelerate inter-VDOM link traffic, assign each interface in the pair to the VDOMs that you want to offload traffic between. For example, if you have added a VDOM named New-VDOM to a FortiGate unit with NP4 processors, you can go to **System > Network > Interfaces** and edit the **npu0-vlink1** interface and set the **Virtual Domain** to **New-VDOM**. This results in an accelerated inter-VDOM link between root and New-VDOM. You can also do this from the CLI:

```
config system interface
  edit npu0-vlink1
    set vdom New-VDOM
end
```

Using VLANs to add more accelerated Inter-VDOM links

You can add VLAN interfaces to the accelerated inter-VDOM links to create inter-VDOM links between more VDOMs. For the links to work, the VLAN interfaces must be added to the same inter-VDOM link, must be on the same subnet, and must have the same VLAN ID.

For example, to accelerate inter-VDOM link traffic between VDOMs named Marketing and Engineering using VLANs with VLAN ID 100 go to **System > Network > Interfaces** and select **Create New** to create the VLAN interface associated with the Marketing VDOM:

Name	Marketing-link
Type	VLAN
Interface	npu0_vlink0
VLAN ID	100
Virtual Domain	Marketing
IP/Network Mask	172.20.120.12/24

Create the inter-VDOM link associated with Engineering VDOM:

Name	Engineering-link
Type	VLAN
Interface	npu0_vlink1

VLAN ID	100
Virtual Domain	Engineering
IP/Network Mask	172.20.120.22/24

Or do the same from the CLI:

```
config system interface
   edit Marketing-link
      set vdom Marketing
      set ip 172.20.120.12/24
      set interface npu0_vlink0
      set vlanid 100
   next
   edit Engineering-link
      set vdom Engineering
      set ip 172.20.120.22/24
      set interface npu0_vlink1
      set vlanid 100
```

Confirm that the traffic is accelerated

Use the following CLI commands to obtain the interface index and then correlate them with the session entries. In the following example traffic was flowing between new accelerated inter-VDOM links and physical ports port1 and port 2 also attached to the NP6 processor.

```
diagnose ip address list
IP=172.31.17.76->172.31.17.76/255.255.252.0 index=5 devname=port1
IP=10.74.1.76->10.74.1.76/255.255.252.0 index=6 devname=port2
IP=172.20.120.12->172.20.120.12/255.255.255.0 index=55 devname=IVL-VLAN1_ROOT
IP=172.20.120.22->172.20.120.22/255.255.255.0 index=56 devname=IVL-VLAN1_VDOM1

diagnose sys session list
session info: proto=1 proto_state=00 duration=282 expire=24 timeout=0 session info:
    proto=1 proto_state=00 duration=124 expire=59 timeout=0 flags=00000000
    sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/
state=may_dirty npu
statistic(bytes/packets/allow_err): org=180/3/1 reply=120/2/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=55->5/5->55
    gwy=172.31.19.254/172.20.120.22
hook=post dir=org act=snat 10.74.2.87:768->10.2.2.2:8(172.31.17.76:62464)
hook=pre dir=reply act=dnat 10.2.2.2:62464->172.31.17.76:0(10.74.2.87:768)
misc=0 policy_id=4 id_policy_id=0 auth_info=0 chk_client_info=0 vd=0
serial=0000004e tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=10.74.2.87, bps=880
npu_state=00000000
npu info: flag=0x81/0x81, offload=8/8, ips_offload=0/0, epid=160/218, ipid=218/160,
    vlan=32769/0
```

```
session info: proto=1 proto_state=00 duration=124 expire=20 timeout=0 flags=00000000
    sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/
state=may_dirty npu
statistic(bytes/packets/allow_err): org=180/3/1 reply=120/2/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=6->56/56->6
    gwy=172.20.120.12/10.74.2.87
hook=pre dir=org act=noop 10.74.2.87:768->10.2.2.2:8(0.0.0.0:0)
hook=post dir=reply act=noop 10.2.2.2:768->10.74.2.87:0(0.0.0.0:0)
misc=0 policy_id=3 id_policy_id=0 auth_info=0 chk_client_info=0 vd=1
serial=0000004d tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=10.74.2.87, bps=880
npu_state=00000000
npu info: flag=0x81/0x81, offload=8/8, ips_offload=0/0, epid=219/161, ipid=161/219,
    vlan=0/32769
total session 2
```

Disabling offloading IPsec Diffie-Hellman key exchange

You can use the following command to disable using ASIC offloading to accelerate IPsec Diffie-Hellman key exchange for IPsec ESP traffic. By default hardware offloading is used. For debugging purposes or other reasons you may want this function to be processed by software.

Use the following command to disable using ASIC offloading for IPsec Diffie Hellman key exchange:

```
config system global
  set ipsec-asic-offload disable
end
```

Configuring individual NP6 processors

You can use the `config system np6` command to configure a wide range of settings for each of the NP6 processors in your FortiGate unit including enabling/disabling fastpath and low latency, enabling session accounting and adjusting session timeouts. As well you can set anomaly checking for IPv4 and IPv6 traffic.

You can also enable and adjust Host Protection Engine (HPE) to protect networks from DoS attacks by categorizing incoming packets based on packet rate and processing cost and applying packet shaping to packets that can cause DoS attacks.

The settings that you configure for an NP6 processor with the `config system np6` command apply to traffic processed by all interfaces connected to that NP6 processor. This includes the physical interfaces connected to the NP6 processor as well as all subinterfaces, VLAN interfaces, IPsec interfaces, LAGs and so on associated with the physical interfaces connected to the NP6 processor.

Some of the options for this command apply anomaly checking for NP6 sessions in the same way as the command described in Offloading NP4 anomaly detection on page 110 applies anomaly checking for NP4 sessions.

```
config system np6
   edit <np6-processor-name>
      set fastpath {disable | enable}
      set low-latency-mode {disable | enable}
      set per-session-accounting {all-enable | disable | enable-by-log}
      set session-timeout-random-range <range>
      set garbage-session-collector {disable | enable}
      set session-collector-interval <range>
      set session-timeout-interval <range>
      set session-timeout-random-range <range>
      set session-timeout-fixed {disable | enable}
         config hpe
            set tcpsyn-max <packets-per-second>
            set tcp-max <packets-per-second>
            set udp-max <packets-per-second>
            set icmp-max <packets-per-second>
            set sctp-max <packets-per-second>
            set esp-max <packets-per-second>
            set ip-frag-max <packets-per-second>
            set ip-others-max <packets-per-second>
            set arp-max <packets-per-second>
            set l2-others-max <packets-per-second>
            set enable-shaper {disable | enable}
         config fp-anomaly
            set tcp-syn-fin {allow | drop | trap-to-host}
            set tcp_fin_noack {allow | drop | trap-to-host}
            set tcp_fin_only {allow | drop | trap-to-host}
            set tcp_no_flag {allow | drop | trap-to-host}
            set tcp_syn_data {allow | drop | trap-to-host}
            set tcp-winnuke {allow | drop | trap-to-host}
            set tcp-land {allow | drop | trap-to-host}
            set udp-land {allow | drop | trap-to-host}
            set icmp-land {allow | drop | trap-to-host}
            set icmp-frag {allow | drop | trap-to-host}
            set ipv4-land {allow | drop | trap-to-host}
            set ipv4-proto-err {allow | drop | trap-to-host}
            set ipv4-unknopt {allow | drop | trap-to-host}
            set ipv4-optrr {allow | drop | trap-to-host}
            set ipv4-optssrr {allow | drop | trap-to-host}
            set ipv4-optlsrr {allow | drop | trap-to-host}
            set ipv4-optstream {allow | drop | trap-to-host}
            set ipv4-optsecurity {allow | drop | trap-to-host}
            set ipv4-opttimestamp {allow | drop | trap-to-host}
            set ipv4-csum-err {drop | trap-to-host}
            set tcp-csum-err {drop | trap-to-host}
            set udp-csum-err {drop | trap-to-host}
            set icmp-csum-err {drop | trap-to-host}
            set ipv6-land {allow | drop | trap-to-host}
            set ipv6-proto-err {allow | drop | trap-to-host}
            set ipv6-unknopt {allow | drop | trap-to-host}
            set ipv6-saddr-err {allow | drop | trap-to-host}
            set ipv6-daddr-err {allow | drop | trap-to-host}
            set ipv6-optralert {allow | drop | trap-to-host}
            set ipv6-optjumbo {allow | drop | trap-to-host}
            set ipv6-opttunnel {allow | drop | trap-to-host}
            set ipv6-opthomeaddr {allow | drop | trap-to-host}
            set ipv6-optnsap {allow | drop | trap-to-host}
```

```
        set ipv6-optendpid {allow | drop | trap-to-host}
        set ipv6-optinvld {allow | drop | trap-to-host}
    end
```

Command syntax

Command	Description	Default
`fastpath {disable | enable}`	Enable fastpath acceleration to offload sessions to the NP6 processor. You can disable fastpath if you don't want the NP6 processor to offload sessions.	enable
`low-latency-mode {disable | enable}`	Enable low-latency mode. In low latency mode the integrated switch fabric is bypassed. Low latency mode requires that packet enter and exit using the same NP6 processor. This option is only available for NP6 processors that can operate in low-latency mode, currently only np6_0 and np6_1 on the FortiGate-3700D and DX.	disable
`per-session-accounting {all-enable | disable | enable-by-log}`	Disable NP6 per-session accounting or enable it and control how it works. If set to `enable-by-log` (the default) NP6 per-session accounting is only enabled if firewall policies accepting offloaded traffic have traffic logging enabled. If set to `all-enable`, NP6 per-session accounting is always enabled for all traffic offloaded by the NP6 processor. Enabling per-session accounting can affect performance.	enable-by-log
`garbage-session-collector {disable | enable}`	Enable deleting expired or garbage sessions.	disable
`session-collector-interval <range>`	Set the expired or garbage session collector time interval in seconds. The range is 1 to 100 seconds.	64
`session-timeout-interval <range>`	Set the timeout for checking for and removing inactive NP6 sessions. The range is 0 to 1000 seconds.	40
`session-timeout-random-range <range>`	Set the random timeout for checking and removing inactive NP6 sessions. The range is 0 to 1000 seconds.	8
`session-timeout-fixed {disable | enable}`	Enable to force checking for and removing inactive NP6 sessions at the `session-timeout-interval` time interval. Set to disable (the default) to check for and remove inactive NP6 sessions at random time intervals.	disable

Command	Description	Default
config hpe		
hpe	Use the following options to use HPE to apply DDoS protection at the NP6 processor by limiting the number packets per second received for various packet types by each NP6 processor. This rate limiting is applied very efficiently because it is done in hardware by the NP6 processor.	
enable-shaper {disable | enable}	Enable or disable HPE DDoS protection.	disable
tcpsyn-max	Limit the maximum number of TCP SYN packets received per second. The range is 10,000 to 4,000,000,000 pps. The default limits the number of packets per second to 5,000,000 pps.	5000000
tcp-max	Limit the maximum number of TCP packets received per second. The range is 10,000 to 4,000,000,000 pps. The default limits the number of packets per second to 5,000,000 pps.	5000000
udp-max	Limit the maximum number of UDP packets received per second. The range is 10,000 to 4,000,000,000 pps. The default limits the number of packets per second to 5,000,000 pps.	5000000
icmp-max	Limit the maximum number of ICMP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000
sctp-max	Limit the maximum number of SCTP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000
esp-max	Limit the maximum number of ESP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000
ip-frag-max	Limit the maximum number of fragmented IP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000
ip-others-max	Limit the maximum number of other types of IP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000

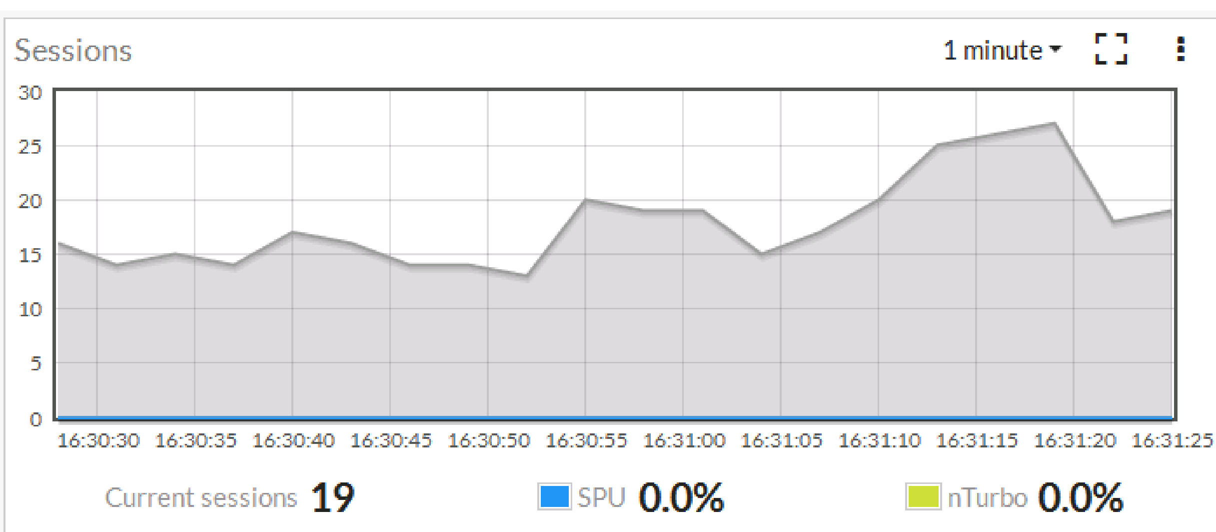
Command	Description	Default
`arp-max`	Limit the maximum number of ARP packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000
`l2-others-max`	Limit the maximum number of other layer-2 packets received. The range is 10,000 to 4,000,000,000 pps. The default is 100,000 pps.	100000
config fp-anomaly		
`fp-anomaly`	Configure how the NP6 processor does traffic anomaly protection. In most cases you can configure the NP6 processor to allow or drop the packets associated with an attack or forward the packets that are associated with the attack to FortiOS (called `trap-to-host`). Selecting `trap-to-host` turns off NP6 anomaly protection for that anomaly. If you require anomaly protection but don't want to use the NP6 processor, you can select `trap-to-host` and enable anomaly protection with a DoS policy.	
`tcp-syn-fin {allow | drop | trap-to-host}`	Detects TCP SYN flood SYN/FIN flag set anomalies.	allow
`tcp_fin_noack {allow | drop | trap-to-host}`	Detects TCP SYN flood with FIN flag set without ACK setting anomalies.	trap-to-host
`tcp_fin_only {allow | drop | trap-to-host}`	Detects TCP SYN flood with only FIN flag set anomalies.	trap-to-host
`tcp_no_flag {allow | drop | trap-to-host}`	Detects TCP SYN flood with no flag set anomalies.	allow
`tcp_syn_data {allow | drop | trap-to-host}`	Detects TCP SYN flood packets with data anomalies.	allow
`tcp-winnuke {allow | drop | trap-to-host}`	Detects TCP WinNuke anomalies.	trap-to-host
`tcp-land {allow | drop | trap-to-host}`	Detects TCP land anomalies.	trap-to-host
`udp-land {allow | drop | trap-to-host}`	Detects UDP land anomalies.	trap-to-host
`icmp-land {allow | drop | trap-to-host}`	Detects ICMP land anomalies.	trap-to-host
`icmp-frag {allow | drop | trap-to-host}`	Detects Layer 3 fragmented packets that could be part of a layer 4 ICMP anomalies.	allow

Command	Description	Default
ipv4-land {allow | drop | trap-to-host}	Detects IPv4 land anomalies.	trap-to-host
ipv4-proto-err {allow | drop | trap-to-host}	Detects invalid layer 4 protocol anomalies.	trap-to-host
ipv4-unknopt {allow | drop | trap-to-host}	Detects unknown option anomalies.	trap-to-host
ipv4-optrr {allow | drop | trap-to-host}	Detects IPv4 with record route option anomalies.	trap-to-host
ipv4-optssrr {allow | drop | trap-to-host}	Detects IPv4 with strict source record route option anomalies.	trap-to-host
ipv4-optlsrr {allow | drop | trap-to-host}	Detects IPv4 with loose source record route option anomalies.	trap-to-host
ipv4-optstream {allow | drop | trap-to-host}	Detects stream option anomalies.	trap-to-host
ipv4-optsecurity {allow | drop | trap-to-host}	Detects security option anomalies.	trap-to-host
ipv4-opttimestamp {allow | drop | trap-to-host}	Detects timestamp option anomalies.	trap-to-host
ipv4-csum-err {drop | trap-to-host}	Detects IPv4 checksum errors.	drop
tcp-csum-err {drop | trap-to-host}	Detects TCP chechsum errors.	drop
udp-csum-err {drop | trap-to-host}	Detects UDP chechsum errors.	drop
icmp-csum-err {drop | trap-to-host}	Detects ICMP chechsum errors.	drop
ipv6-land {allow | drop | trap-to-host}	Detects IPv6 land anomalies	trap-to-host
ipv6-unknopt {allow | drop | trap-to-host}	Detects unknown option anomalies.	trap-to-host
ipv6-saddr-err {allow | drop | trap-to-host}	Detects source address as multicast anomalies.	trap-to-host

Command	Description	Default
`ipv6-daddr_err {allow	drop	trap-to-host}`	Detects destination address as unspecified or loopback address anomalies.	trap-to-host
`ipv6-optralert {allow	drop	trap-to-host}`	Detects router alert option anomalies.	trap-to-host
`ipv6-optjumbo {allow	drop	trap-to-host}`	Detects jumbo options anomalies.	trap-to-host
`ipv6-opttunnel {allow	drop	trap-to-host}`	Detects tunnel encapsulation limit option anomalies.	trap-to-host
`ipv6-opthomeaddr {allow	drop	trap-to-host}`	Detects home address option anomalies.	trap-to-host
`ipv6-optnsap {allow	drop	trap-to-host}`	Detects network service access point address option anomalies.	trap-to-host
`ipv6-optendpid {allow	drop	trap-to-host}`	Detects end point identification anomalies.	trap-to-host
`ipv6-optinvld {allow	drop	trap-to-host}`	Detects invalid option anomalies.	trap-to-host

Enabling per-session accounting for offloaded NP6 or NP6lite sessions

Per-session accounting is a logging feature that allows the FortiGate to report the correct bytes/pkt numbers per session for sessions offloaded to an NP6 processor. This information appears in traffic log messages as well as in FortiView. The following example shows the Sessions dashboard widget tracking SPU and nTurbo sessions.



You can hover over the SPU icon to see some information about the offloaded sessions.

You configure per-session accounting for each NP6 processor. For example, use the following command to enable per-session accounting for NP6_0 and NP6_1:

```
config system np6
  edit np6_0
    set per-session-accounting enable-by-log
  next
  edit np6_1
    set per-session-accounting enable-by-log
  end
```

If your FortiGate has NP6lite processors, you can use the following command to enable per-session accounting for all of the NP6lite processors in the FortiGate unit:

```
config system npu
  set per-session-accounting enable-by-log
end
```

The option, `enable-by-log` enables per-session accounting for offloaded sessions with traffic logging enabled and `all-enable` enables per-session accounting for all offloaded sessions.

By default, `per-session-accounting` is set to `enable-by-log`, which results in per-session accounting being turned on when you enable traffic logging in a policy.

Per-session accounting can affect offloading performance. So you should only enable per-session accounting if you need the accounting information.

Enabling per-session accounting does not provide traffic flow data for sFlow or NetFlow.

Configuring NP6 session timeouts

For NP6 traffic, FortiOS refreshes an NP6 session's lifetime when it receives a session update message from the NP6 processor. To avoid session update message congestion, these NP6 session checks are performed all at once after a random time interval and all of the update messages are sent from the NP6 processor to FortiOS at once. This can result in fewer messages being sent because they are only sent at random time intervals instead of every time a session times out.

In fact, if your NP6 processor is processing a lot of short lived sessions, it is recommended that you use the default setting of random checking every 8 seconds to avoid very bursty session updates. If the time between session updates is very long and very many sessions have been expired between updates a large number of updates will need to be done all at once.

You can use the following command to set the random time range.

```
config system np6
  edit <np6-processor-name>
    set session-timeout-fixed disable
    set session-timeout-random-range 8
  end
```

This is the default configuration. The random timeout range is 1 to 1000 seconds and the default range is 8. So, by default, NP6 sessions are checked at random time intervals of between 1 and 8 seconds. So sessions can be inactive for up to 8 seconds before they are removed from the FortiOS session table.

If you want to reduce the amount of checking you can increase the `session-timeout-random-range`. This could result in inactive sessions being kept in the session table longer. But if most of your NP6 sessions are relatively long this shouldn't be a problem.

You can also change this session checking to a fixed time interval and set a fixed timeout:

```
config system np6
   edit <np6-processor-name>
      set session-timeout-fixed enable
      set session-timeout-fixed 40
   end
```

The fixed timeout default is every 40 seconds and the rang is 1 to 1000 seconds. Using a fixed interval further reduces the amount of checking that occurs.

You can select random or fixed updates and adjust the time intervals to minimize the refreshing that occurs while still making sure inactive sessions are deleted regularly. For example, if an NP6 processor is processing sessions with long lifetimes you can reduce checking by setting a relatively long fixed timeout.

Configure the number of IPsec engines NP6 processors use

NP6 processors use multiple IPsec engines to accelerate IPsec encryption and decryption. In some cases out of order ESP packets can cause problems if multiple IPsec engines are running. To resolve this problem you can configure all of the NP6 processors to use fewer IPsec engines.

Use the following command to change the number of IPsec engines used for decryption (`ipsec-dec-subengine-mask`) and encryption (`ipsec-enc-subengine-mask`). These settings are applied to all of the NP6 processors in the FortiGate unit.

```
config system npu
   set ipsec-dec-subengine-mask <engine-mask>
   set ipsec-enc-subengine-mask <engine-mask>
end
```

`<engine-mask>` is a hexadecimal number in the range 0x01 to 0xff where each bit represents one IPsec engine. The default `<engine-mask>` for both options is 0xff which means all IPsec engines are used. Add a lower `<engine-mask>` to use fewer engines. You can configure different engine masks for encryption and decryption.

Stripping clear text padding and IPsec session ESP padding

In some situations, when clear text or ESP packets in IPsec sessions may have large amounts of layer 2 padding, the NP6 IPsec engine may not be able to process them and the session may be blocked.

If you notice dropped IPsec sessions, you could try using the following CLI options to cause the NP6 processor to strip clear text padding and ESP padding before send the packets to the IPsec engine. With padding stripped, the session can be processed normally by the IPsec engine.

Use the following command to strip ESP padding:

```
config system npu
   set strip-esp-padding enable
   set strip-clear-text-padding enable
end
```

Stripping clear text and ESP padding are both disabled by default.

Disable NP6 CAPWAP offloading

By default and where possible, managed FortiAP and FortiLink CAPWAP sessions are offloaded to NP6 processors. You can use the following command to disable CAWAP session offloading:

```
config system npu
   set capwap-offload disable
end
```

Optionally disable NP6 offloading of traffic passing between 10Gbps and 1Gbps interfaces

Due to NP6 internal packet buffer limitations, some offloaded packets received at a 10Gbps interface and destined for a 1Gbps interface can be dropped, reducing performance for TCP and IP tunnel traffic. If you experience this performance reduction, you can use the following command to disable offloading sessions passing from 10Gbps interfaces to 1Gbps interfaces:

```
config system npu
   set host-shortcut-mode host-shortcut
end
```

Select `host-shortcut` to stop offloading TCP and IP tunnel packets passing from 10Gbps interfaces to 1Gbps interfaces. TCP and IP tunnel packets passing from 1Gbps interfaces to 10Gbps interfaces are still offloaded as normal.

If `host-shortcut` is set to the default `bi-directional` setting, packets in both directions are offloaded.

This option is only available if your FortiGate has 10G and 1G interfaces accelerated by NP6 processors.

Enabling bandwidth control between the ISF and NP6 XAUI ports

In some cases, the Internal Switch Fabric (ISF) buffer size may be larger than the buffer size of an NP6 XAUI port that receives traffic from the ISF. If this happens, burst traffic from the ISF may exceed the capacity of an XAUI port and sessions may be dropped.

You can use the following command to configure bandwidth control between the ISF and XAUI ports. Enabling bandwidth control can smooth burst traffic and keep the XAUI ports from getting overwhelmed and dropping sessions.

Use the following command to enable bandwidth control:

```
config system npu
   set sw-np-bandwidth {0G | 2G | 4G | 5G | 6G}
end
```

The default setting is `0G` which means no bandwidth control. The other options limit the bandwidth to 2Gbps, 4Gbps and so on.

NP6 session drift

In some cases, sessions processed by NP6 processors may fail to be deleted leading to a large number of idle sessions. This is called session drift. You can use SNMP to be alerted when the number of idle sessions becomes high. SNMP also allows you to see which NP6 processor has the abnormal number of idle sessions and you can use a diagnose command to delete them.

The following MIB fields allow you to use SNMP to monitor session table information for NP6 processors including drift for each NP6 processor:

```
FORTINET-FORTIGATE-MIB::fgNPUNumber.0 = INTEGER: 2
FORTINET-FORTIGATE-MIB::fgNPUName.0 = STRING: NP6
FORTINET-FORTIGATE-MIB::fgNPUDrvDriftSum.0 = INTEGER: 0
FORTINET-FORTIGATE-MIB::fgNPUIndex.0 = INTEGER: 0
FORTINET-FORTIGATE-MIB::fgNPUIndex.1 = INTEGER: 1
FORTINET-FORTIGATE-MIB::fgNPUSessionTblSize.0 = Gauge32: 33554432
FORTINET-FORTIGATE-MIB::fgNPUSessionTblSize.1 = Gauge32: 33554432
FORTINET-FORTIGATE-MIB::fgNPUSessionCount.0 = Gauge32: 0
FORTINET-FORTIGATE-MIB::fgNPUSessionCount.1 = Gauge32: 0
FORTINET-FORTIGATE-MIB::fgNPUDrvDrift.0 = INTEGER: 0
FORTINET-FORTIGATE-MIB::fgNPUDrvDrift.1 = INTEGER: 0
```

You can also use the following diagnose command to determine of drift is occurring:

```
diagnose npu np6 sse-drift-summary
NPU   drv-drift
----- ---------
np6_0 0
np6_1 0
----- ---------
Sum   0
----- ---------
```

The command output shows a drift summary for all the NP6 processors in the system, and shows the total drift. Normally the sum is 0. The previous command output, from a FortiGate-1500D, shows that the 1500D's two NP6 processors are not experiencing any drift.

If the sum is not zero, then extra idle sessions may be accumulating. You can use the following command to delete those sessions:

```
diagnose npu np6 sse-purge-drift <np6_id> [<time>]
```

Where `<np6_id>` is the number (starting with NP6_0 with a np6_id of 0) of the NP6 processor for which to delete idle sessions in. `<time>` is the age in seconds of the idle sessions to be deleted. All idle sessions this age and older are deleted. The default time is 300 seconds.

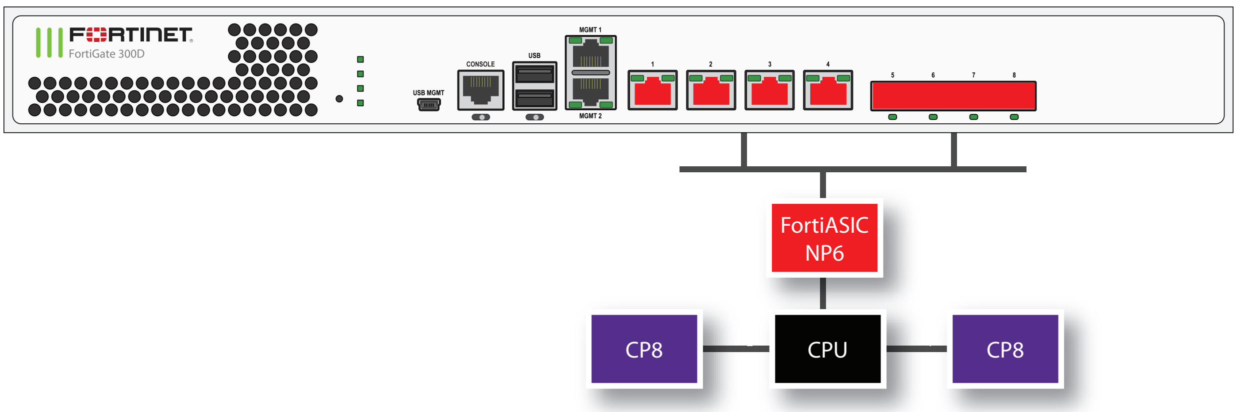
The `diagnose npu np6 sse-stats <np6_id>` command output also includes a `drv-drift` field that shows the total drift for one NP6 processor.

FortiGate NP6 architectures

This chapter shows the NP6 architecture for the all FortiGate models that include NP6 processors.

FortiGate-300D fast path architecture

The FortiGate-300D includes one NP6 processor connected to four 1Gb RJ-45 Ethernet ports (port1-4) and four 1Gb SFP interfaces (port5-port8).



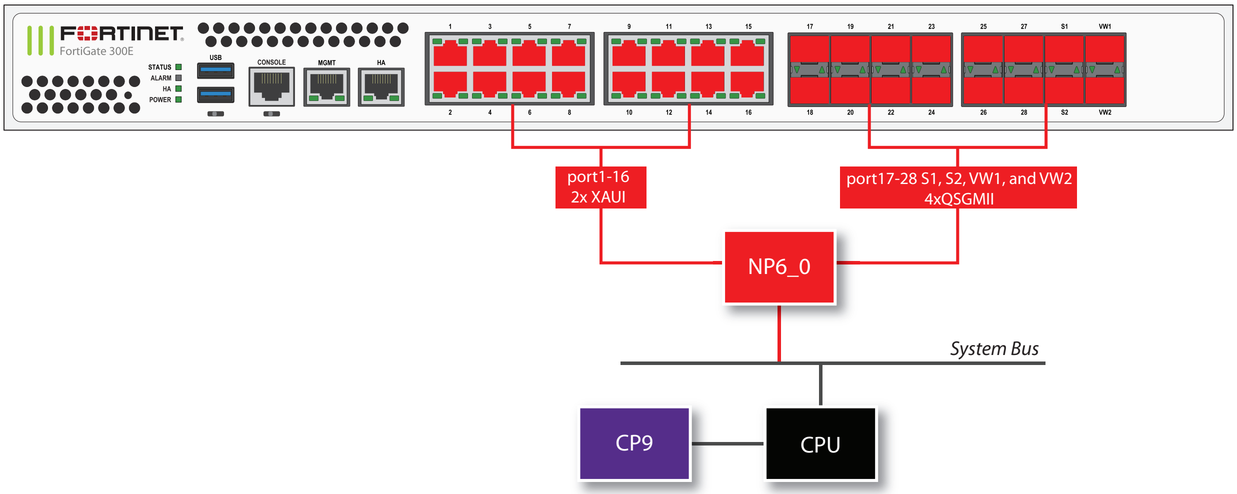
You can use the following get command to display the FortiGate-300D NP6 configuration. The command output shows one NP6 named NP6_0 and the interfaces (ports) connected to it. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip    XAUI Ports    Max   Cross-chip
                      Speed offloading
------ ---- ------- ----- ----------
np6_0   0
        1    port5   1G    Yes
        1    port7   1G    Yes
        1    port8   1G    Yes
        1    port6   1G    Yes
        1    port3   1G    Yes
        1    port4   1G    Yes
        1    port1   1G    Yes
        1    port2   1G    Yes
        2
        3
------ ---- ------- ----- ----------
```

FortiGate-300E and 301E fast path architecture

The FortiGate-300E and 301E each include one NP6 processor. All front panel data interfaces (port1 to 28, S1, S2, VW1, and VW2) connect to the NP6 processor. So all supported traffic passing between any two data interfaces can be offloaded.

The following diagram also shows the XAUI and QSGMII port connections between the NP6 processor and the front panel interfaces.



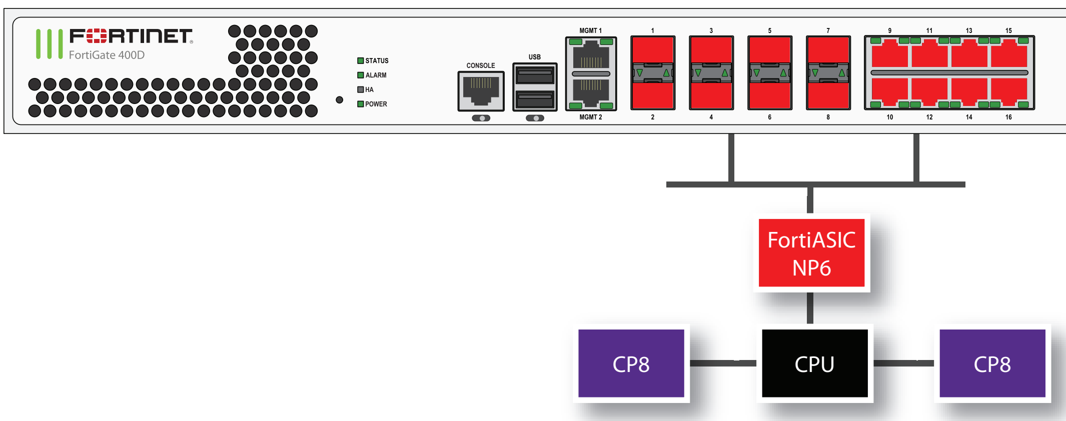
You can use the following get command to display the FortiGate-300E or 301E NP6 configuration. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports        Max   Cross-chip
                         Speed offloading
------ ---- -------      ----- ----------
np6_0   0   port1         1G    Yes
        0   port2         1G    Yes
        0   port3         1G    Yes
        0   port4         1G    Yes
        0   port5         1G    Yes
        0   port6         1G    Yes
        0   port7         1G    Yes
        0   port8         1G    Yes
        1   port9         1G    Yes
        1   port10        1G    Yes
        1   port11        1G    Yes
        1   port12        1G    Yes
        1   port13        1G    Yes
        1   port14        1G    Yes
        1   port15        1G    Yes
        1   port16        1G    Yes
        2   port17        1G    Yes
        2   port18        1G    Yes
        2   port19        1G    Yes
```

```
          2     port20       1G    Yes
          2     port21       1G    Yes
          2     port22       1G    Yes
          2     port23       1G    Yes
          2     port2        1G    Yes
          3     port25       1G    Yes
          3     port26       1G    Yes
          3     port27       1G    Yes
          3     port28       1G    Yes
          3     s1           1G    Yes
          3     s2           1G    Yes
          3     vw1          1G    Yes
          3     vw2          1G    Yes
------ ---- ------- ----- ----------
```

FortiGate-400D fast path architecture

The FortiGate-400D includes one NP6 processor connected to eight 1Gb SFP interfaces (port1-port8) and eight 1Gb RJ-45 Ethernet ports (port9-16).



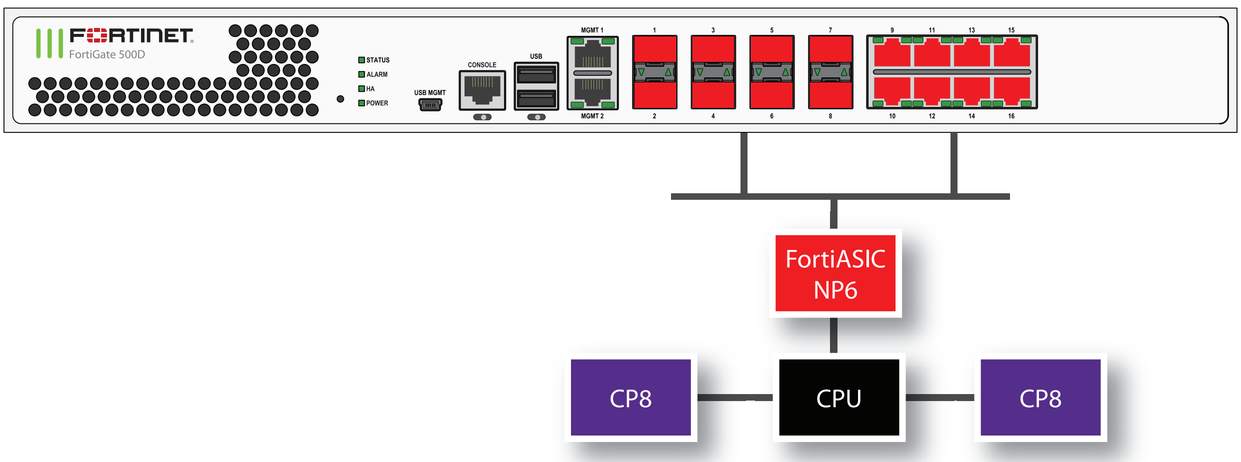
You can use the following get command to display the FortiGate-400D NP6 configuration. The command output shows one NP6 named NP6_0 and the interfaces (ports) connected to it. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                   Speed offloading
------ ---- ------- ----- ----------
np6_0  0
        1    port10  1G    Yes
        1    port9   1G    Yes
        1    port12  1G    Yes
        1    port11  1G    Yes
        1    port14  1G    Yes
        1    port13  1G    Yes
        1    port16  1G    Yes
        1    port15  1G    Yes
```

```
           1    port5   1G    Yes
           1    port7   1G    Yes
           1    port8   1G    Yes
           1    port6   1G    Yes
           1    port3   1G    Yes
           1    port4   1G    Yes
           1    port1   1G    Yes
           1    port2   1G    Yes
           2
           3
------ ---- ------- ----- ----------
```

FortiGate-500D fast path architecture

The FortiGate-500D includes one NP6 processor connected to eight 1Gb SFP interfaces (port1-port8) and eight 1Gb RJ-45 Ethernet ports (port9-16).



You can use the following get command to display the FortiGate-500D NP6 configuration. The command output shows one NP6 named NP6_0 and the interfaces (ports) connected to it. You can also use the `diagnose npu np6 port-list` command to display this information.

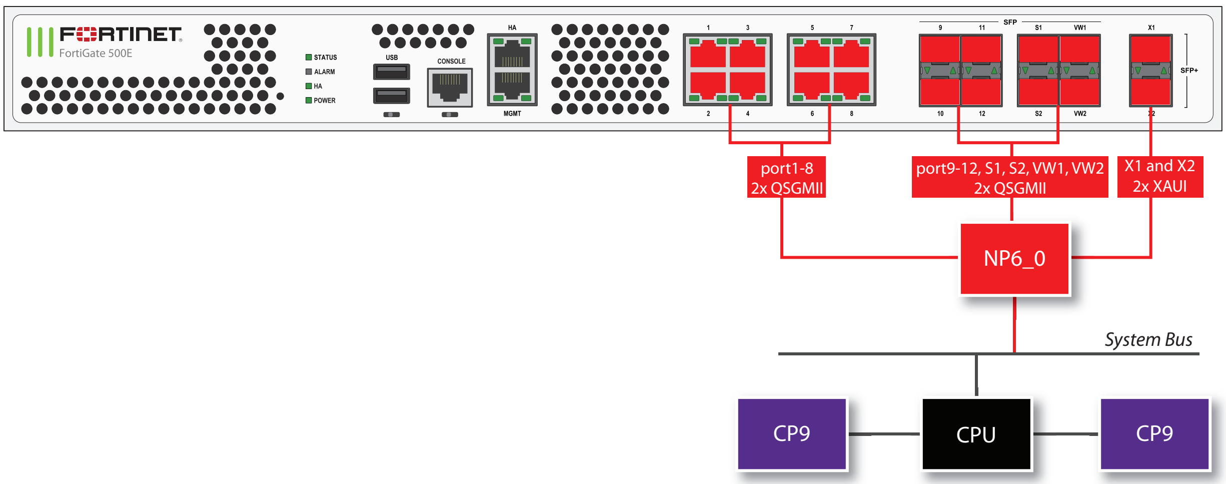
```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0
       1    port10  1G    Yes
       1    port9   1G    Yes
       1    port12  1G    Yes
       1    port11  1G    Yes
       1    port14  1G    Yes
       1    port13  1G    Yes
       1    port16  1G    Yes
       1    port15  1G    Yes
       1    port5   1G    Yes
       1    port7   1G    Yes
       1    port8   1G    Yes
       1    port6   1G    Yes
```

```
              1    port3   1G    Yes
              1    port4   1G    Yes
              1    port1   1G    Yes
              1    port2   1G    Yes
              2
              3
------ ---- ------- ----- ----------
```

FortiGate-500E and 501E fast path architecture

The FortiGate-500E and 501E each include one NP6 processor. All front panel data interfaces (port1 to 212, S1, S2, VW1, VW2, X1 and X2) connect to the NP6 processor. So all supported traffic passing between any two data interfaces can be offloaded.

The following diagram also shows the QSGMII and XAUI port connections between the NP6 processor and the front panel interfaces.



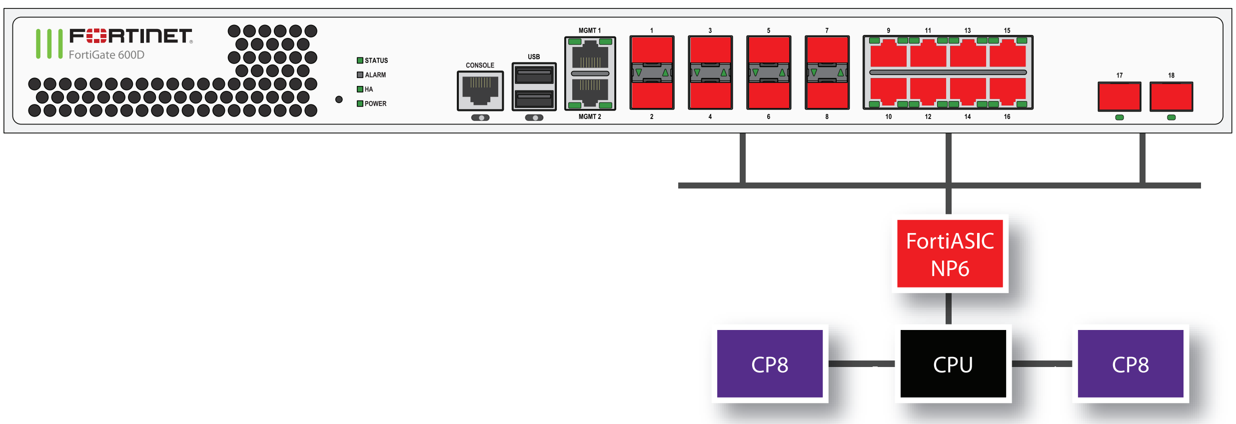
You can use the following get command to display the FortiGate-500E or 501E NP6 configuration. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports        Max  Cross-chip
                         Speed offloading
------ ---- -------      ----- ----------
np6_0   0   x1           10G  Yes
        1   port1        1G   Yes
        1   port2        1G   Yes
        1   port3        1G   Yes
        1   port4        1G   Yes
        1   port5        1G   Yes
        1   port6        1G   Yes
        1   port7        1G   Yes
        1   port8        1G   Yes
        1   port9        1G   Yes
        1   port10       1G   Yes
        1   port11       1G   Yes
```

```
          1     port12        1G    Yes
          1     s1            1G    Yes
          1     s2            1G    Yes
          1     vw1           1G    Yes
          1     vw2           1G    Yes
          2     x2            10G   Yes
          3
------ ---- ------- ----- ----------
```

FortiGate-600D fast path architecture

The FortiGate-600D includes one NP6 processor connected to eight 1Gb SFP interfaces (port1-port8) and eight 1Gb RJ-45 Ethernet ports (port9-16) and two 10Gb SFP+ interfaces (port17 and port18).



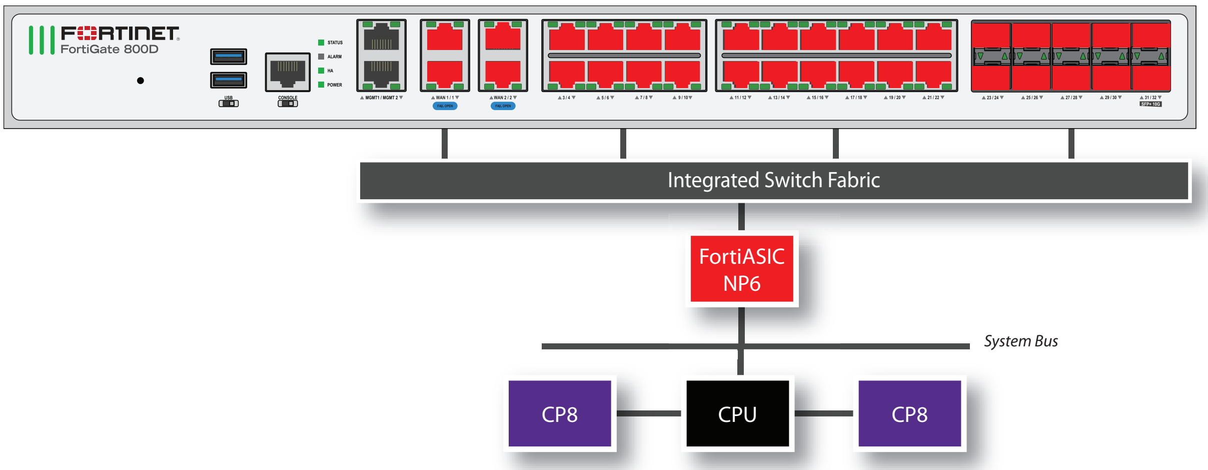
You can use the following get command to display the FortiGate-600D NP6 configuration. The command output shows one NP6 named NP6_0 and the interfaces (ports) connected to it. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip    XAUI  Ports    Max    Cross-chip
                       Speed  offloading
------ ---- ------- ----- ----------
np6_0   0
        1     port10   1G     Yes
        1     port9    1G     Yes
        1     port12   1G     Yes
        1     port11   1G     Yes
        1     port14   1G     Yes
        1     port13   1G     Yes
        1     port16   1G     Yes
        1     port15   1G     Yes
        1     port5    1G     Yes
        1     port7    1G     Yes
        1     port8    1G     Yes
        1     port6    1G     Yes
        1     port3    1G     Yes
        1     port4    1G     Yes
        1     port1    1G     Yes
        1     port2    1G     Yes
```

```
          2    port17  10G   Yes
          3    port18  10G   Yes
------ ---- ------- ----- ----------
```

FortiGate-800D fast path architecture

The FortiGate-800D includes one NP6 processor connected through an integrated switch fabric to all of the FortiGate-800D network interfaces. This hardware configuration supports NP6-accelerated fast path offloading for sessions between any of the FortiGate-800D interfaces.



You can use the following get command to display the FortiGate-800D NP6 configuration. The command output shows one NP6 named NP6_0. The output also shows all of the FortiGate-800D interfaces (ports) connected to NP6_0. You can also use the `diagnose npu np6 port-list` command to display this information.

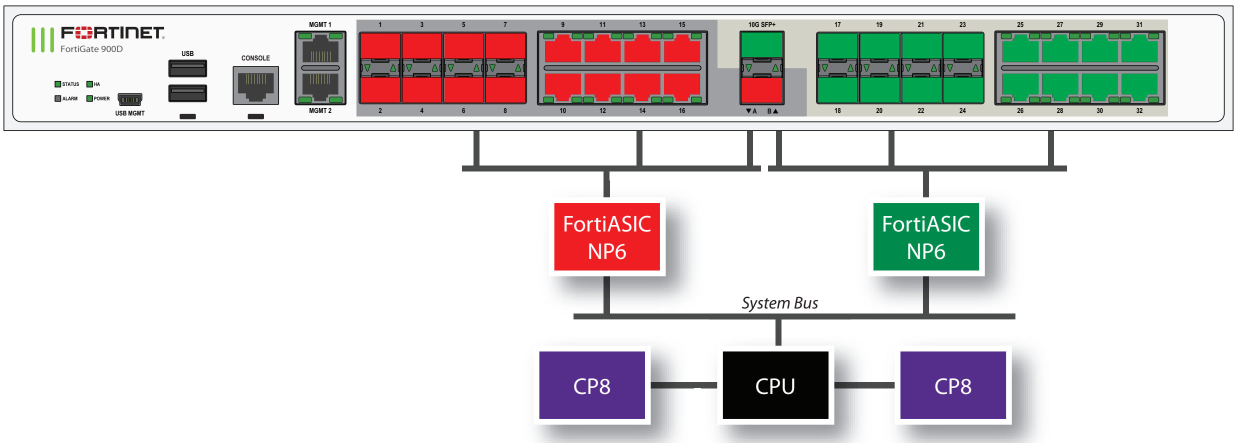
```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0    port31  10G   Yes
       1    wan1    1G    Yes
       1    port1   1G    Yes
       1    wan2    1G    Yes
       1    port2   1G    Yes
       1    port3   1G    Yes
       1    port4   1G    Yes
       1    port5   1G    Yes
       1    port6   1G    Yes
       1    port30  1G    Yes
       1    port29  1G    Yes
       1    port28  1G    Yes
       1    port27  1G    Yes
       1    port26  1G    Yes
       1    port25  1G    Yes
       1    port24  1G    Yes
       1    port23  1G    Yes
       2    port7   1G    Yes
       2    port8   1G    Yes
       2    port9   1G    Yes
       2    port10  1G    Yes
       2    port11  1G    Yes
       2    port12  1G    Yes
       2    port13  1G    Yes
       2    port14  1G    Yes
       2    port15  1G    Yes
       2    port16  1G    Yes
       2    port17  1G    Yes
       2    port18  1G    Yes
       2    port19  1G    Yes
       2    port20  1G    Yes
       2    port21  1G    Yes
       2    port22  1G    Yes
       3    port32  10G   Yes
------ ---- ------- ----- ----------
```

FortiGate-900D fast path architecture

The FortiGate-900D includes two NP6 processors that are not connected by an integrated switch fabric (ISF). Without an ISF, traffic through a FortiGate-900D could experience lower latency than traffic through similar hardware with an ISF. The NP6 processors are connected to network interfaces as follows:

Because the FortiGate-900D does not have an ISF you cannot create Link Aggregation Groups (LAGs) that include interfaces connected to both NP6 processors.

- Eight 1Gb SFP interfaces (port17-port24), eight 1Gb RJ-45 Ethernet interfaces (port25-32) and one 10Gb SFP+ interface (portB) share connections to the first NP6 processor.
- Eight 1Gb SFP interfaces (port1-port8), eight RJ-45 Ethernet interfaces (port9-16) and one 10Gb SFP+ interface (portA) share connections to the second NP6 processor.



You can use the following get command to display the FortiGate-900D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

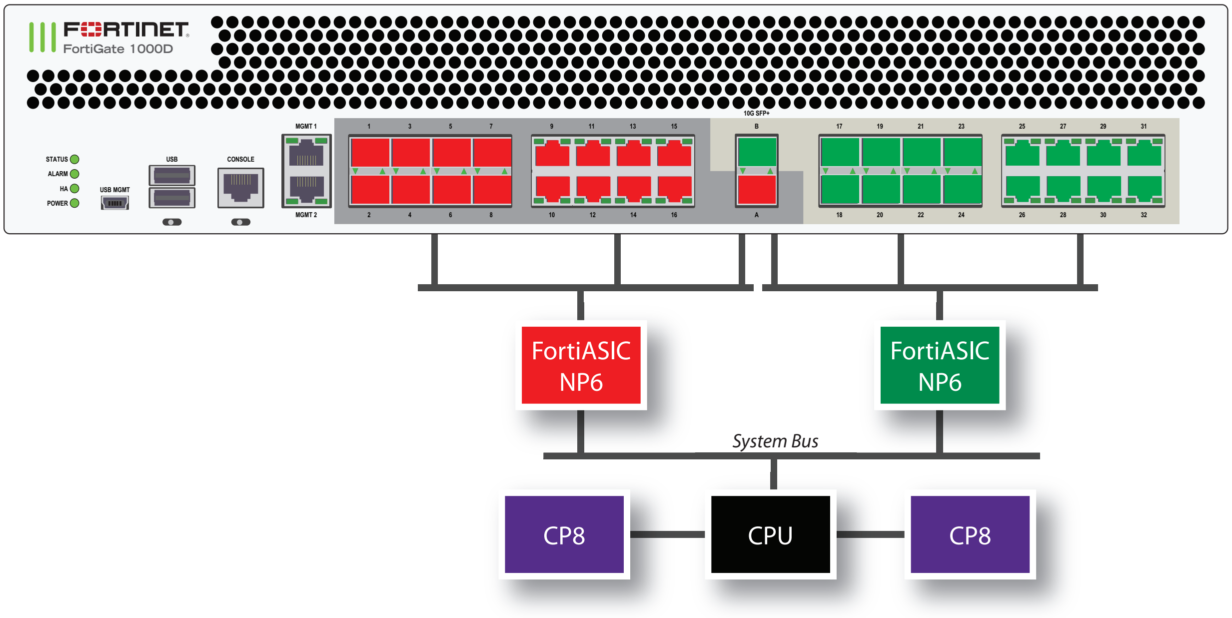
```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0
       1    port17  1G    Yes
       1    port18  1G    Yes
       1    port19  1G    Yes
       1    port20  1G    Yes
       1    port21  1G    Yes
       1    port22  1G    Yes
       1    port23  1G    Yes
       1    port24  1G    Yes
       1    port27  1G    Yes
       1    port28  1G    Yes
       1    port25  1G    Yes
       1    port26  1G    Yes
       1    port31  1G    Yes
       1    port32  1G    Yes
       1    port29  1G    Yes
       1    port30  1G    Yes
       2    portB   10G   Yes
       3
------ ---- ------- ----- ----------
np6_1   0
        1    port1  1G    Yes
        1    port2  1G    Yes
        1    port3  1G    Yes
        1    port4  1G    Yes
        1    port5  1G    Yes
        1    port6  1G    Yes
        1    port7  1G    Yes
        1    port8  1G    Yes
        1    port11 1G    Yes
        1    port12 1G    Yes
        1    port9  1G    Yes
        1    port10 1G    Yes
        1    port15 1G    Yes
        1    port16 1G    Yes
        1    port13 1G    Yes
        1    port14 1G    Yes
        2    portA  10G   Yes
        3
```

FortiGate-1000D fast path architecture

The FortiGate-1000D includes two NP6 processors that are not connected by an integrated switch fabric (ISF). The NP6 processors are connected to network interfaces as follows:

Because the FortiGate-1000D does not have an ISF you cannot create Link Aggregation Groups (LAGs) or redundant interfaces that include interfaces connected to both NP6 processors.

- Eight 1Gb SFP interfaces (port17-port24), eight 1Gb RJ-45 Ethernet interfaces (port25-32) and one 10Gb SFP+ interface (portB) share connections to the first NP6 processor.
- Eight 1Gb SFP interfaces (port1-port8), eight RJ-45 Ethernet interfaces (port9-16) and one 10Gb SFP+ interface (portA) share connections to the second NP6 processor.



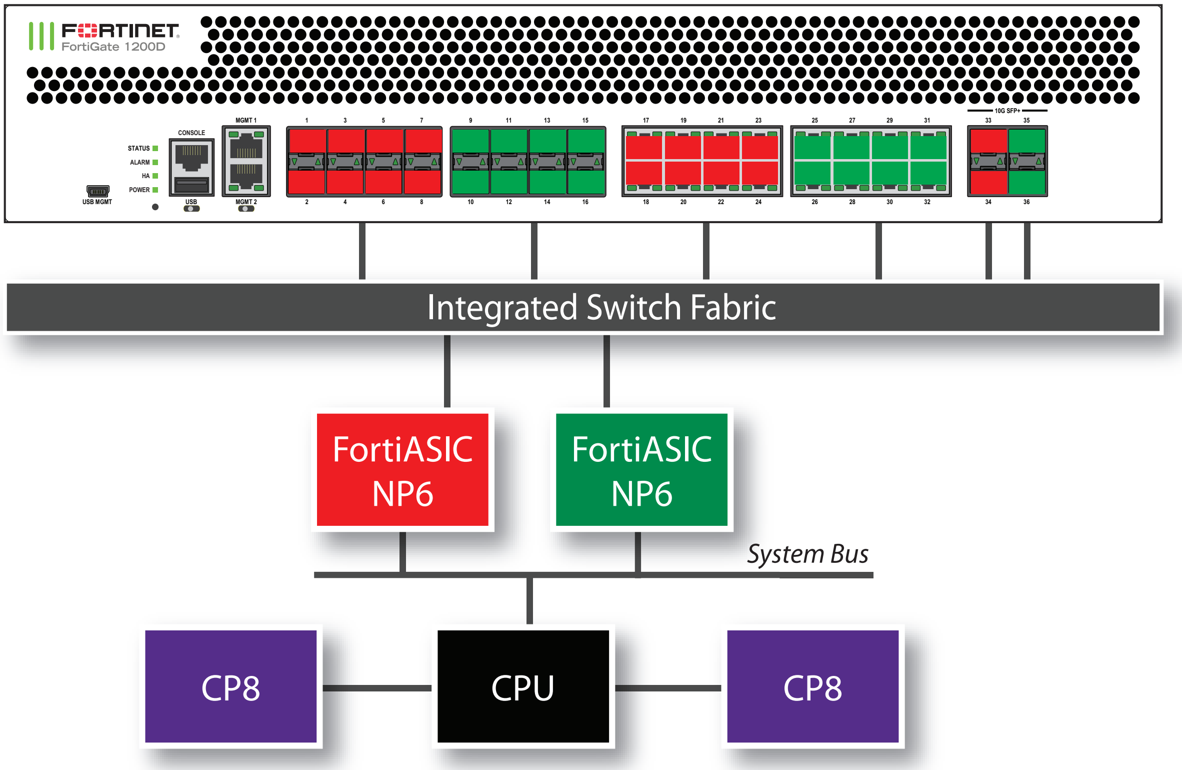
You can use the following get command to display the FortiGate-1000D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0
        1    port17  1G    Yes
        1    port18  1G    Yes
        1    port19  1G    Yes
        1    port20  1G    Yes
        1    port21  1G    Yes
        1    port22  1G    Yes
        1    port23  1G    Yes
        1    port24  1G    Yes
        1    port27  1G    Yes
        1    port28  1G    Yes
        1    port25  1G    Yes
        1    port26  1G    Yes
        1    port31  1G    Yes
        1    port32  1G    Yes
        1    port29  1G    Yes
        1    port30  1G    Yes
        2    portB   10G   Yes
        3
------ ---- ------- ----- ----------
np6_1   0
         1    port1  1G    Yes
         1    port2  1G    Yes
         1    port3  1G    Yes
         1    port4  1G    Yes
         1    port5  1G    Yes
         1    port6  1G    Yes
         1    port7  1G    Yes
         1    port8  1G    Yes
         1    port11 1G    Yes
         1    port12 1G    Yes
         1    port9  1G    Yes
         1    port10 1G    Yes
         1    port15 1G    Yes
         1    port16 1G    Yes
         1    port13 1G    Yes
         1    port14 1G    Yes
         2    portA  10G   Yes
         3
```

FortiGate-1200D fast path architecture

The FortiGate-1200D features two NP6 processors both connected to an integrated switch fabric.

- Eight SFP 1Gb interfaces (port1-port8), eight RJ-45 Ethernet ports (port17-24) and two SFP+ 10Gb interfaces (port33 and port34) share connections to the first NP6 processor.
- Eight SFP 1Gb interfaces (port9-port16), eight RJ-45 Ethernet ports (port25-32) and two SFP+ 10Gb interfaces (port35-port36) share connections to the second NP6 processor.



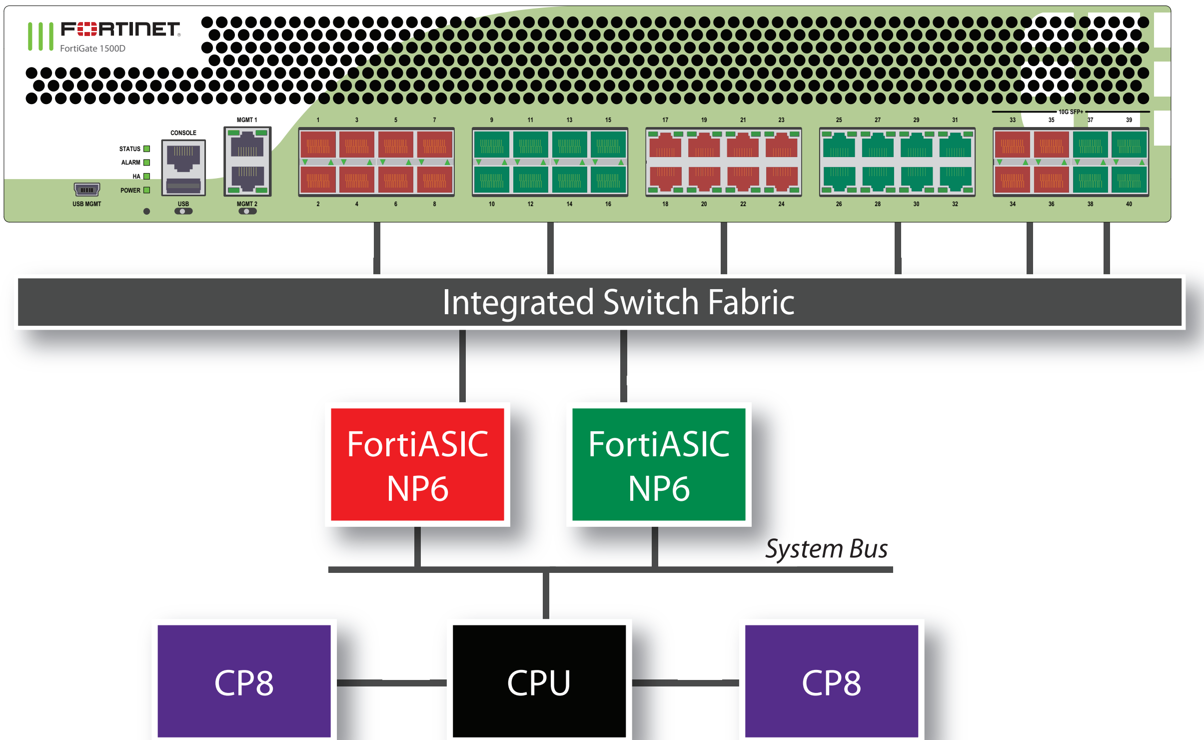
You can use the following get command to display the FortiGate-1200D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0    port33  10G   Yes
       1    port34  10G   Yes
       2    port1   1G    Yes
       2    port3   1G    Yes
       2    port5   1G    Yes
       2    port7   1G    Yes
       2    port17  1G    Yes
       2    port19  1G    Yes
       2    port21  1G    Yes
       2    port23  1G    Yes
       3    port2   1G    Yes
       3    port4   1G    Yes
       3    port6   1G    Yes
       3    port8   1G    Yes
       3    port18  1G    Yes
       3    port20  1G    Yes
       3    port22  1G    Yes
       3    port24  1G    Yes
------ ---- ------- ----- ----------
np6_1  0    port35  10G   Yes
       1    port36  10G   Yes
       2    port9   1G    Yes
       2    port11  1G    Yes
       2    port13  1G    Yes
       2    port15  1G    Yes
       2    port25  1G    Yes
       2    port27  1G    Yes
       2    port29  1G    Yes
       2    port31  1G    Yes
       3    port10  1G    Yes
       3    port12  1G    Yes
       3    port14  1G    Yes
       3    port16  1G    Yes
       3    port26  1G    Yes
       3    port28  1G    Yes
       3    port30  1G    Yes
       3    port32  1G    Yes
------ ---- ------- ----- ----------
```

FortiGate-1500D fast path architecture

The FortiGate-1500D features two NP6 processors both connected to an integrated switch fabric.

- Eight SFP 1Gb interfaces (port1-port8), eight RJ-45 1Gb Ethernet interfaces (port17-24) and four SFP+ 10Gb interfaces (port33-port36) share connections to the first NP6 processor.
- Eight SFP 1Gb interfaces (port9-port16), eight RJ-45 1Gb Ethernet interfaces (port25-32) and four SFP+ 10Gb interfaces (port37-port40) share connections to the second NP6 processor.



You can use the following get command to display the FortiGate-1500D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6_0  0    port1            1G    Yes
       0    port5            1G    Yes
       0    port17           1G    Yes
       0    port21           1G    Yes
       0    port33           10G   Yes
       1    port2            1G    Yes
       1    port6            1G    Yes
       1    port18           1G    Yes
       1    port22           1G    Yes
       1    port34           10G   Yes
```

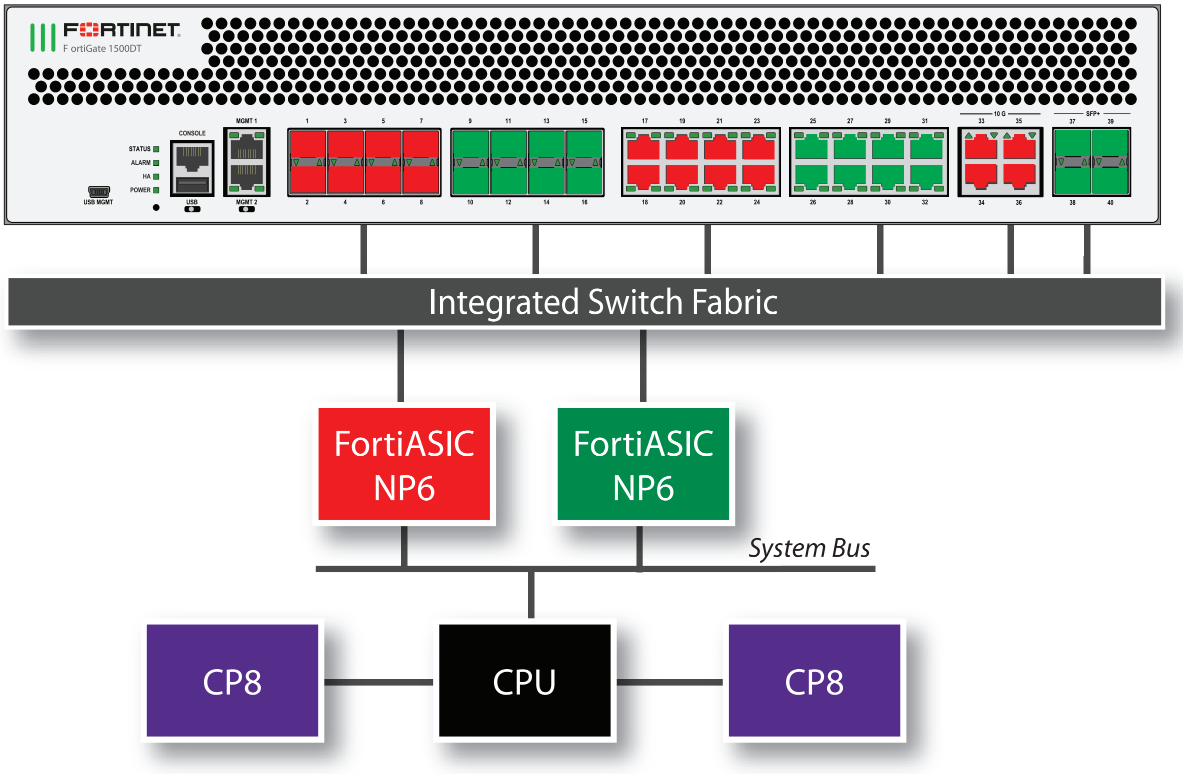
```
       2    port3           1G    Yes
       2    port7           1G    Yes
       2    port19          1G    Yes
       2    port23          1G    Yes
       2    port35          10G   Yes
       3    port4           1G    Yes
       3    port8           1G    Yes
       3    port20          1G    Yes
       3    port24          1G    Yes
       3    port36          10G   Yes
------ ---- -------         ----- ----------
np6_1  0    port9           1G    Yes
       0    port13          1G    Yes
       0    port25          1G    Yes
       0    port29          1G    Yes
       0    port37          10G   Yes
       1    port10          1G    Yes
       1    port14          1G    Yes
       1    port26          1G    Yes
       1    port30          1G    Yes
       1    port38          10G   Yes
       2    port11          1G    Yes
       2    port15          1G    Yes
       2    port27          1G    Yes
       2    port31          1G    Yes
       2    port39          10G   Yes
       3    port12          1G    Yes
       3    port16          1G    Yes
       3    port28          1G    Yes
       3    port32          1G    Yes
       3    port40          10G   Yes
------ ---- -------         ----- ----------
```

FortiGate-1500DT fast path architecture

The FortiGate-1500DT features two NP6 processors both connected to an integrated switch fabric. The FortiGate-1500DT has the same hardware configuration as the FortiGate-1500D, but with the addition of newer CPUs.

The FortiGate-1500DT includes the following interfaces and NP6 processors:

- Eight SFP 1Gb interfaces (port1-port8), eight RJ-45 1Gb Ethernet interfaces (port17-24) and four RJ-45 10Gb Ethernet interfaces (port33-port36) share connections to the first NP6 processor.
- Eight SFP 1Gb interfaces (port9-port16), eight RJ-45 1Gb Ethernet ports (port25-32) and four SFP+ 10Gb interfaces (port37-port40) share connections to the second NP6 processor.



You can use the following get command to display the FortiGate-1500DT NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0    port1   1G    Yes
       0    port5   1G    Yes
       0    port17  1G    Yes
       0    port21  1G    Yes
       0    port33  10G   Yes
       1    port2   1G    Yes
       1    port6   1G    Yes
       1    port18  1G    Yes
       1    port22  1G    Yes
       1    port34  10G   Yes
       2    port3   1G    Yes
       2    port7   1G    Yes
       2    port19  1G    Yes
       2    port23  1G    Yes
       2    port35  10G   Yes
       3    port4   1G    Yes
       3    port8   1G    Yes
       3    port20  1G    Yes
       3    port24  1G    Yes
       3    port36  10G   Yes
```

```
------ ---- ------- ----- ----------
np6_1  0    port9   1G    Yes
       0    port13  1G    Yes
       0    port25  1G    Yes
       0    port29  1G    Yes
       0    port37  10G   Yes
       1    port10  1G    Yes
       1    port14  1G    Yes
       1    port26  1G    Yes
       1    port30  1G    Yes
       1    port38  10G   Yes
       2    port11  1G    Yes
       2    port15  1G    Yes
       2    port27  1G    Yes
       2    port31  1G    Yes
       2    port39  10G   Yes
       3    port12  1G    Yes
       3    port16  1G    Yes
       3    port28  1G    Yes
       3    port32  1G    Yes
       3    port40  10G   Yes
------ ---- ------- ----- ----------
```

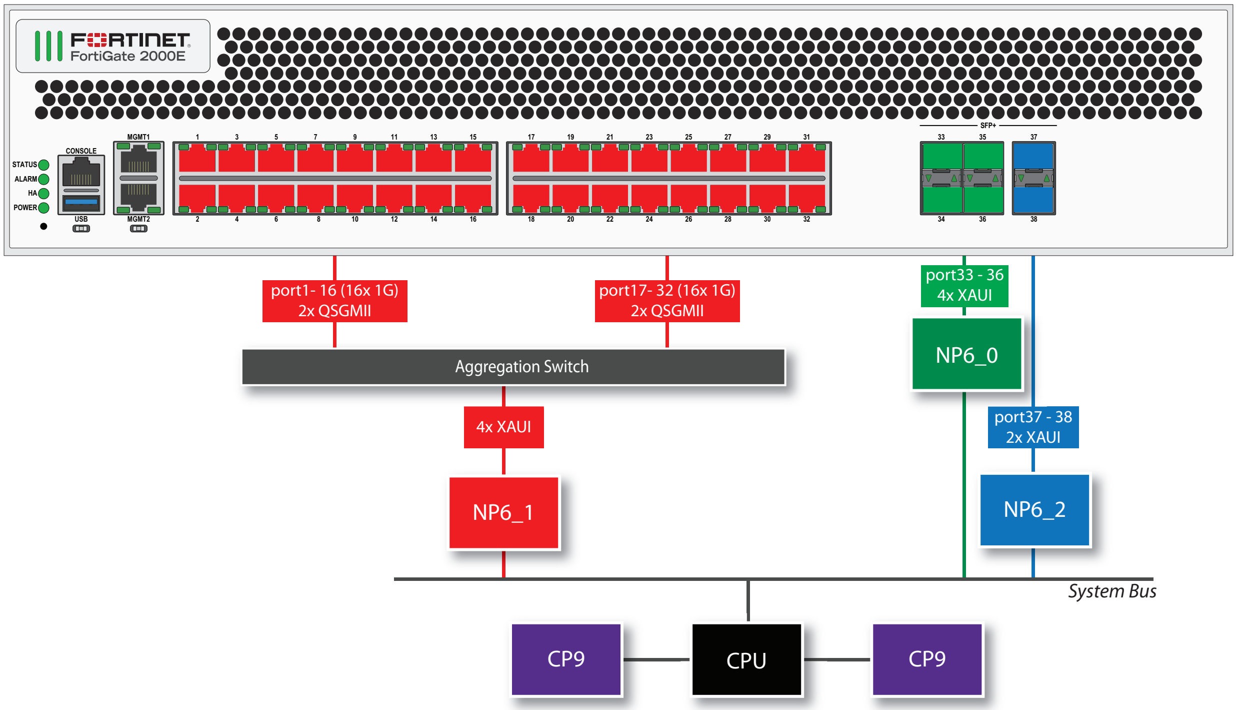
FortiGate-2000E fast path architecture

The FortiGate-2000E includes three NP6 processors in an NP Direct configuration. The NP6 processors connected to the 10GigE ports are also in a low latency NP Direct configuration. Because of NP Direct, you cannot create Link Aggregation Groups (LAGs) or redundant interfaces between interfaces connected to different NP6s. As well, traffic will only be offloaded if it enters and exits the FortiGate on interfaces connected to the same NP6.

The NP6s are connected to network interfaces as follows:

- NP6_0 is connected to four 10GigE SFP+ interfaces (port33 to port36) in a low latency configuration.
- NP6_1 is connected to thirty-two 10/100/1000BASE-T interfaces (port1 to port32).
- NP6_2 is connected to two 10GigE SFP+ (port37 and port38) in a low latency configuration.

The following diagram also shows the XAUI and QSGMII port connections between the NP6 processors and the front panel interfaces and the aggregate switch for the thirty-two 10/100/1000BASE-T interfaces.



You can use the following get command to display the FortiGate-2000E NP6 configuration. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_1  0    port1   1G    No
       0    port5   1G    No
       0    port9   1G    No
       0    port13  1G    No
       0    port17  1G    No
       0    port21  1G    No
       0    port25  1G    No
       0    port29  1G    No
       1    port2   1G    No
       1    port6   1G    No
       1    port10  1G    No
       1    port14  1G    No
       1    port18  1G    No
       1    port22  1G    No
       1    port26  1G    No
       1    port30  1G    No
       2    port3   1G    No
       2    port7   1G    No
       2    port11  1G    No
       2    port15  1G    No
       2    port19  1G    No
       2    port23  1G    No
       2    port27  1G    No
       2    port31  1G    No
       3    port4   1G    No
       3    port8   1G    No
       3    port12  1G    No
       3    port16  1G    No
       3    port20  1G    No
       3    port24  1G    No
       3    port28  1G    No
       3    port32  1G    No
------ ---- ------- ----- ----------
np6_0  0    port33  10G   No
       1    port34  10G   No
       2    port35  10G   No
       3    port36  10G   No
------ ---- ------- ----- ----------
np6_2  0    port37  10G   No
       1    port38  10G   No
------ ---- ------- ----- ----------
```

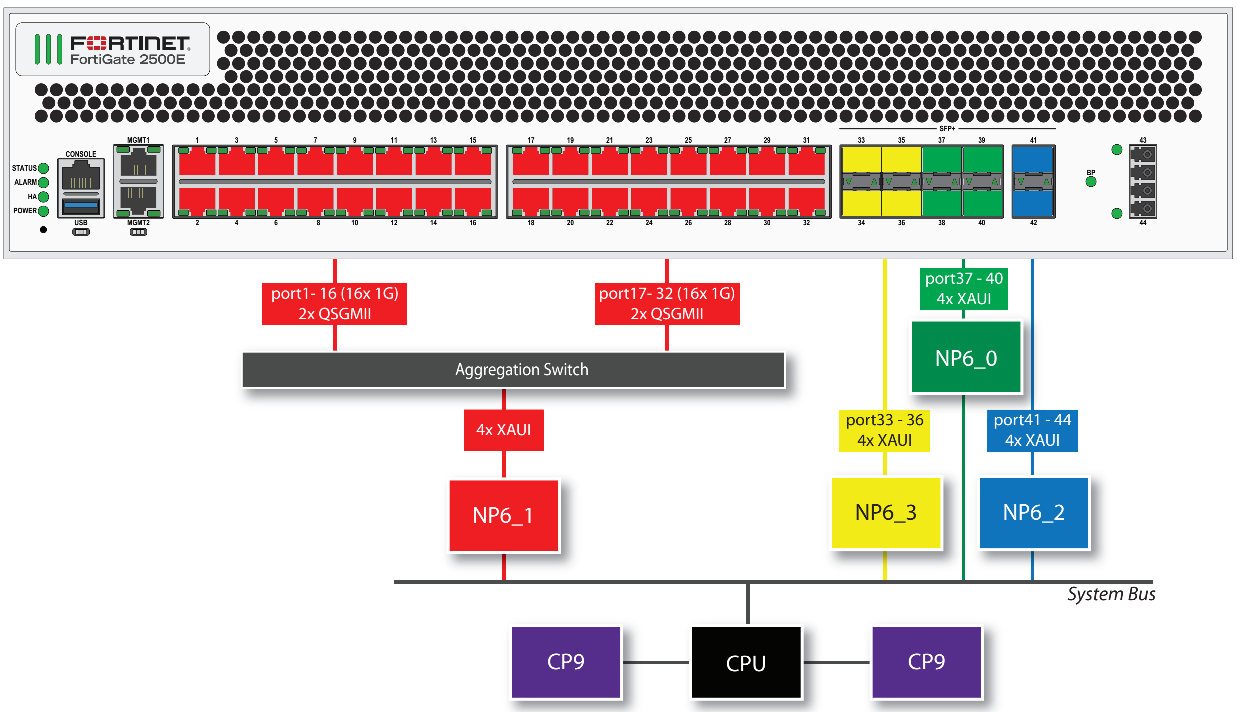
FortiGate-2500E fast path architecture

The FortiGate-2500E includes four NP6 processors in an NP Direct configuration. The NP6 processors connected to the 10GigE ports are also in a low latency NP Direct configuration. Because of NP Direct, you cannot create Link Aggregation Groups (LAGs) or redundant interfaces between interfaces connected to different NP6s. As well, traffic will only be offloaded if it enters and exits the FortiGate on interfaces connected to the same NP6.

The NP6s are connected to network interfaces as follows:

- NP6_0 is connected to four 10GigE SFP+ interfaces (port37 to port40) in a low latency configuration.
- NP6_1 is connected to thirty-two 10/100/1000BASE-T interfaces (port1 to port32).
- NP6_2 is connected to two 10GigE SFP+ interfaces (port41 and port42) and two 10 Gig fiber bypass interfaces (port43 and port44) in a low latency configuration.
- NP6_3 is connected to four 10GigE SFP+ interfaces (port33 to port36) in a low latency configuration.

The following diagram also shows the XAUI and QSGMII port connections between the NP6 processors and the front panel interfaces and the aggregate switch for the thirty-two 10/100/1000BASE-T interfaces.



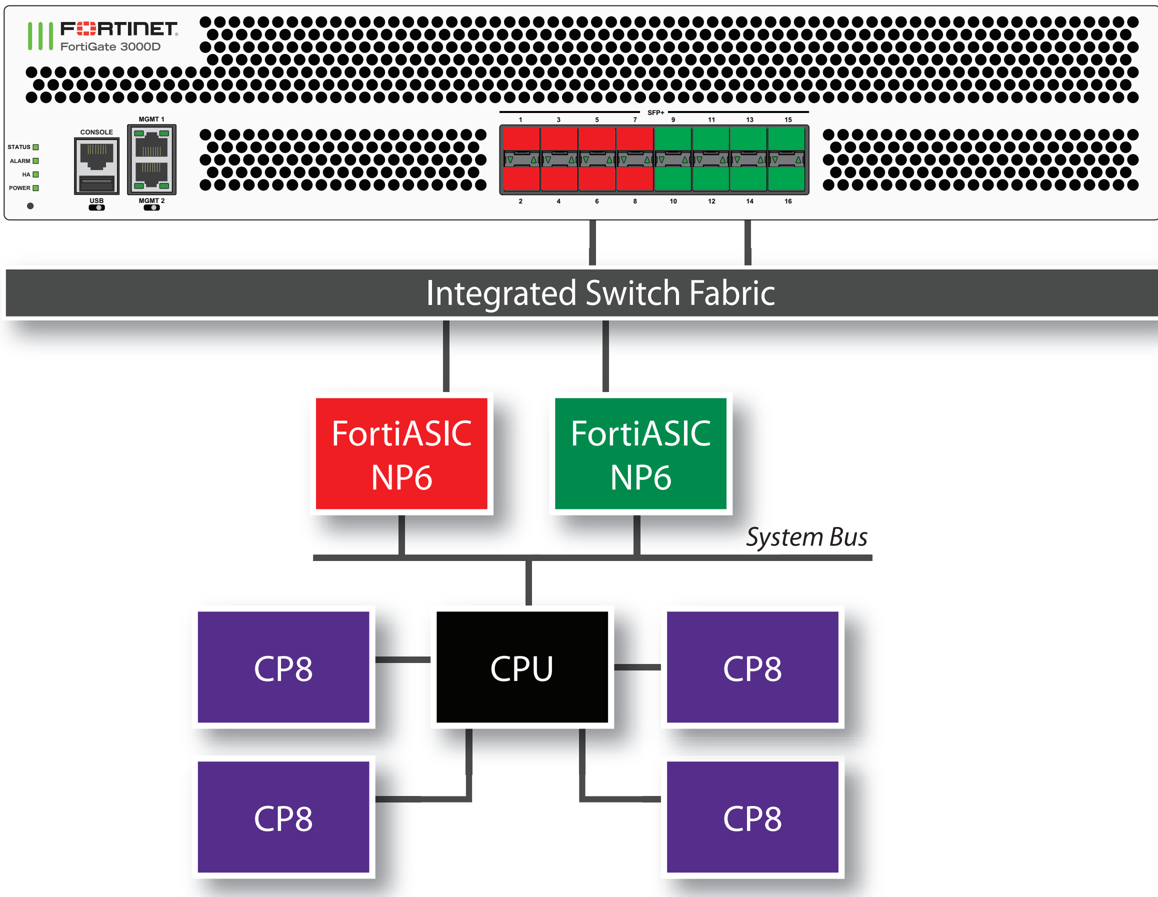
You can use the following get command to display the FortiGate-2500E NP6 configuration. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_1  0    port1   1G    No
       0    port5   1G    No
       0    port9   1G    No
       0    port13  1G    No
       0    port17  1G    No
       0    port21  1G    No
       0    port25  1G    No
       0    port29  1G    No
       1    port2   1G    No
       1    port6   1G    No
       1    port10  1G    No
       1    port14  1G    No
       1    port18  1G    No
       1    port22  1G    No
       1    port26  1G    No
       1    port30  1G    No
       2    port3   1G    No
       2    port7   1G    No
       2    port11  1G    No
       2    port15  1G    No
       2    port19  1G    No
       2    port23  1G    No
       2    port27  1G    No
       2    port31  1G    No
       3    port4   1G    No
       3    port8   1G    No
       3    port12  1G    No
       3    port16  1G    No
       3    port20  1G    No
       3    port24  1G    No
       3    port28  1G    No
       3    port32  1G    No
------ ---- ------- ----- ----------
np6_0  0    port37  10G   No
       1    port38  10G   No
       2    port39  10G   No
       3    port40  10G   No
------ ---- ------- ----- ----------
np6_2  0    port43  10G   No
       1    port44  10G   No
       2    port41  10G   No
       3    port42  10G   No
------ ---- ------- ----- ----------
np6_3  0    port33  10G   No
       1    port34  10G   No
       2    port35  10G   No
       3    port36  10G   No
------ ---- ------- ----- ----------
```

FortiGate-3000D fast path architecture

The FortiGate-3000D features 16 front panel SFP+ 10Gb interfaces connected to two NP6 processors through an Integrated Switch Fabirc (ISF). The FortiGate-3000D has the following fastpath architecture:

- 8 SFP+ 10Gb interfaces, port1 through port8 share connections to the first NP6 processor (np6_0).
- 8 SFP+ 10Gb interfaces, port9 through port16 share connections to the second NP6 processor (np6_1).



You can use the following get command to display the FortiGate-3000D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

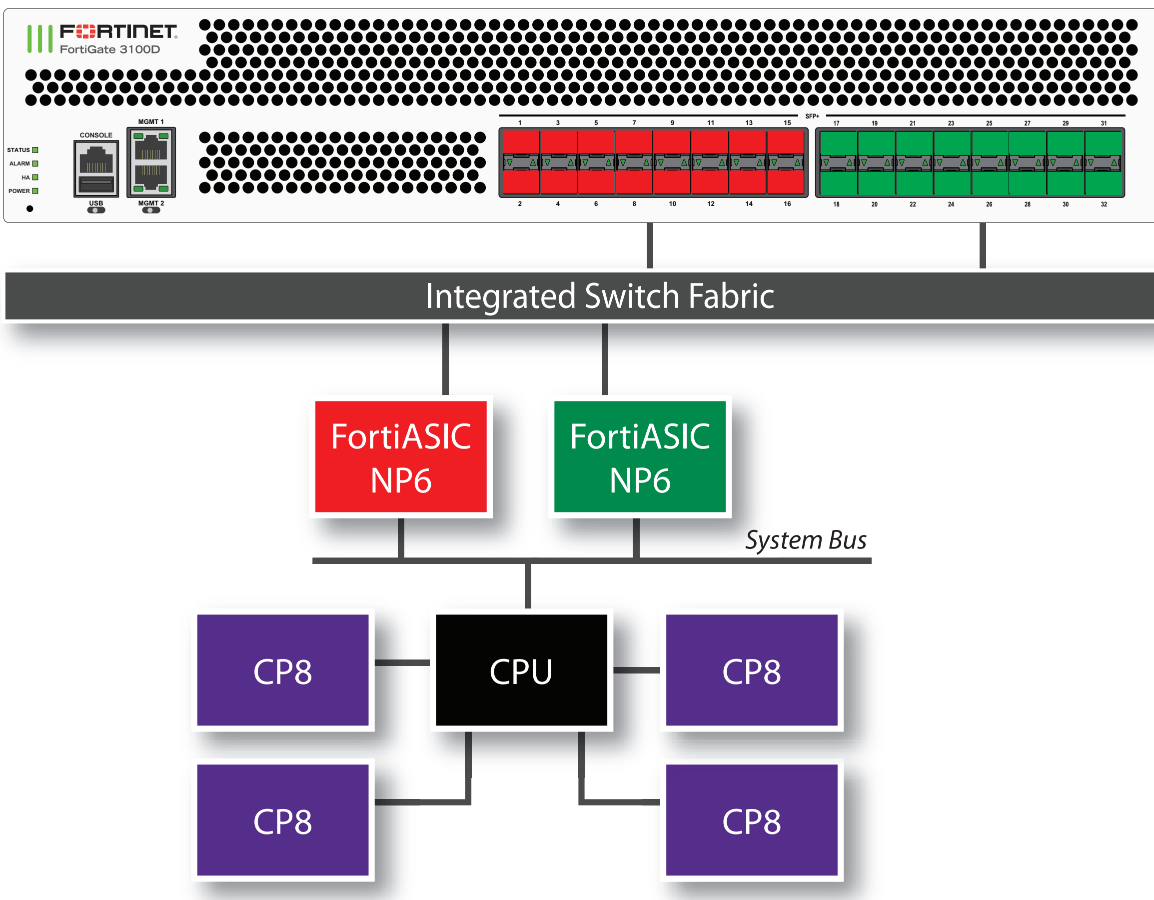
```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0    port1   10G   Yes
       0    port6   10G   Yes
       1    port2   10G   Yes
       1    port5   10G   Yes
       2    port3   10G   Yes
       2    port8   10G   Yes
```

```
        3    port4   10G   Yes
        3    port7   10G   Yes
------ ---- ------- ----- ----------
np6_1  0    port10  10G   Yes
       0    port13  10G   Yes
       1    port9   10G   Yes
       1    port14  10G   Yes
       2    port12  10G   Yes
       2    port15  10G   Yes
       3    port11  10G   Yes
       3    port16  10G   Yes
------ ---- ------- ----- ----------
```

FortiGate-3100D fast path architecture

The FortiGate-3100D features 32 SFP+ 10Gb interfaces connected to two NP6 processors through an Integrated Switch Fabirc (ISF). The FortiGate-3100D has the following fastpath architecture:

- 16 SFP+ 10Gb interfaces, port1 through port16 share connections to the first NP6 processor (np6_0).
- 16 SFP+ 10Gb interfaces, port27 through port32 share connections to the second NP6 processor (np6_1).



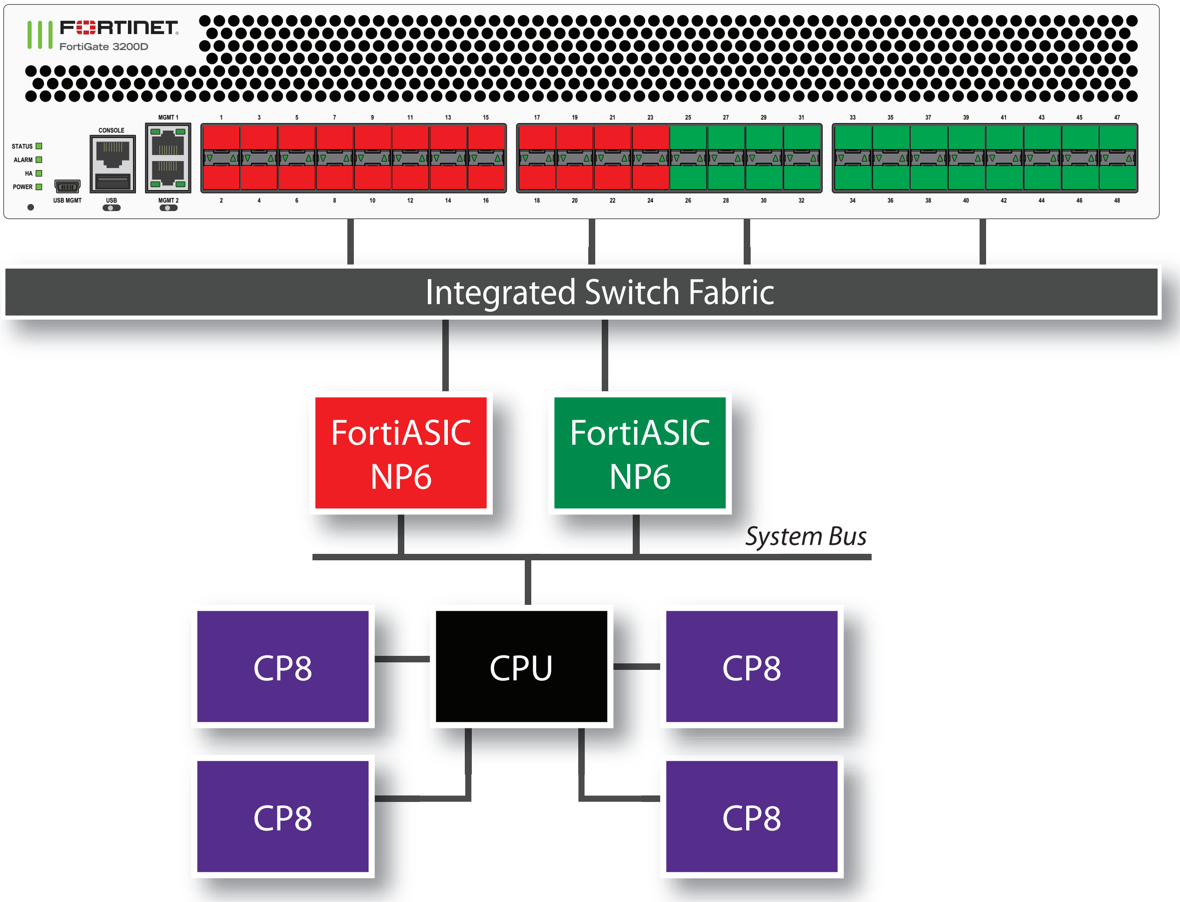
You can use the following get command to display the FortiGate-3100D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0    port1   10G   Yes
       0    port6   10G   Yes
       0    port10  10G   Yes
       0    port13  10G   Yes
       1    port2   10G   Yes
       1    port5   10G   Yes
       1    port9   10G   Yes
       1    port14  10G   Yes
       2    port3   10G   Yes
       2    port8   10G   Yes
       2    port12  10G   Yes
       2    port15  10G   Yes
       3    port4   10G   Yes
       3    port7   10G   Yes
       3    port11  10G   Yes
       3    port16  10G   Yes
------ ---- ------- ----- ----------
np6_1  0    port17  10G   Yes
       0    port21  10G   Yes
       0    port25  10G   Yes
       0    port29  10G   Yes
       1    port18  10G   Yes
       1    port22  10G   Yes
       1    port26  10G   Yes
       1    port30  10G   Yes
       2    port19  10G   Yes
       2    port23  10G   Yes
       2    port27  10G   Yes
       2    port31  10G   Yes
       3    port20  10G   Yes
       3    port24  10G   Yes
       3    port28  10G   Yes
       3    port32  10G   Yes
------ ---- ------- ----- ----------
```

FortiGate-3200D fast path architecture

The FortiGate-3200D features two NP6 processors connected to an Integrated Switch Fabirc (ISF). The FortiGate-3200D has the following fastpath architecture:

- 24 SFP+ 10Gb interfaces, port1 through port24 share connections to the first NP6 processor (np6_0).
- 24 SFP+ 10Gb interfaces, port25 through port48 share connections to the second NP6 processor (np6_1).



You can use the following get command to display the FortiGate-3200D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_0  0    port1   10G   Yes
       0    port5   10G   Yes
       0    port10  10G   Yes
       0    port13  10G   Yes
       0    port17  10G   Yes
       0    port22  10G   Yes
       1    port2   10G   Yes
       1    port6   10G   Yes
       1    port9   10G   Yes
       1    port14  10G   Yes
       1    port18  10G   Yes
       1    port21  10G   Yes
       2    port3   10G   Yes
       2    port7   10G   Yes
       2    port12  10G   Yes
```

```
       2    port15  10G   Yes
       2    port19  10G   Yes
       2    port24  10G   Yes
       3    port4   10G   Yes
       3    port8   10G   Yes
       3    port11  10G   Yes
       3    port16  10G   Yes
       3    port20  10G   Yes
       3    port23  10G   Yes
------ ---- ------- ----- ----------
np6_1  0    port26  10G   Yes
       0    port29  10G   Yes
       0    port33  10G   Yes
       0    port37  10G   Yes
       0    port41  10G   Yes
       0    port45  10G   Yes
       1    port25  10G   Yes
       1    port30  10G   Yes
       1    port34  10G   Yes
       1    port38  10G   Yes
       1    port42  10G   Yes
       1    port46  10G   Yes
       2    port28  10G   Yes
       2    port31  10G   Yes
       2    port35  10G   Yes
       2    port39  10G   Yes
       2    port43  10G   Yes
       2    port47  10G   Yes
       3    port27  10G   Yes
       3    port32  10G   Yes
       3    port36  10G   Yes
       3    port40  10G   Yes
       3    port44  10G   Yes
       3    port48  10G   Yes
------ ---- ------- ----- ----------
```

FortiGate-3700D fast path architecture

The FortiGate-3700D features four NP6 processors.The first two NP6 processors (np6_0 and np6_1) can be configured for low latency operation. The low latency configuration changes the FortiGate-3700D fast path architecture.

FortiGate-3700D low latency fast path architecture

Ports 25 to 32 can be used for low latency offloading. As long as traffic enters and exits the FortiGate-3700D through ports connected to the same NP6 processor and using these low latency ports the traffic will be offloaded and have lower latency that other NP6 offloaded traffic. Latency is reduced by bypassing the integrated switch fabric (ISF).

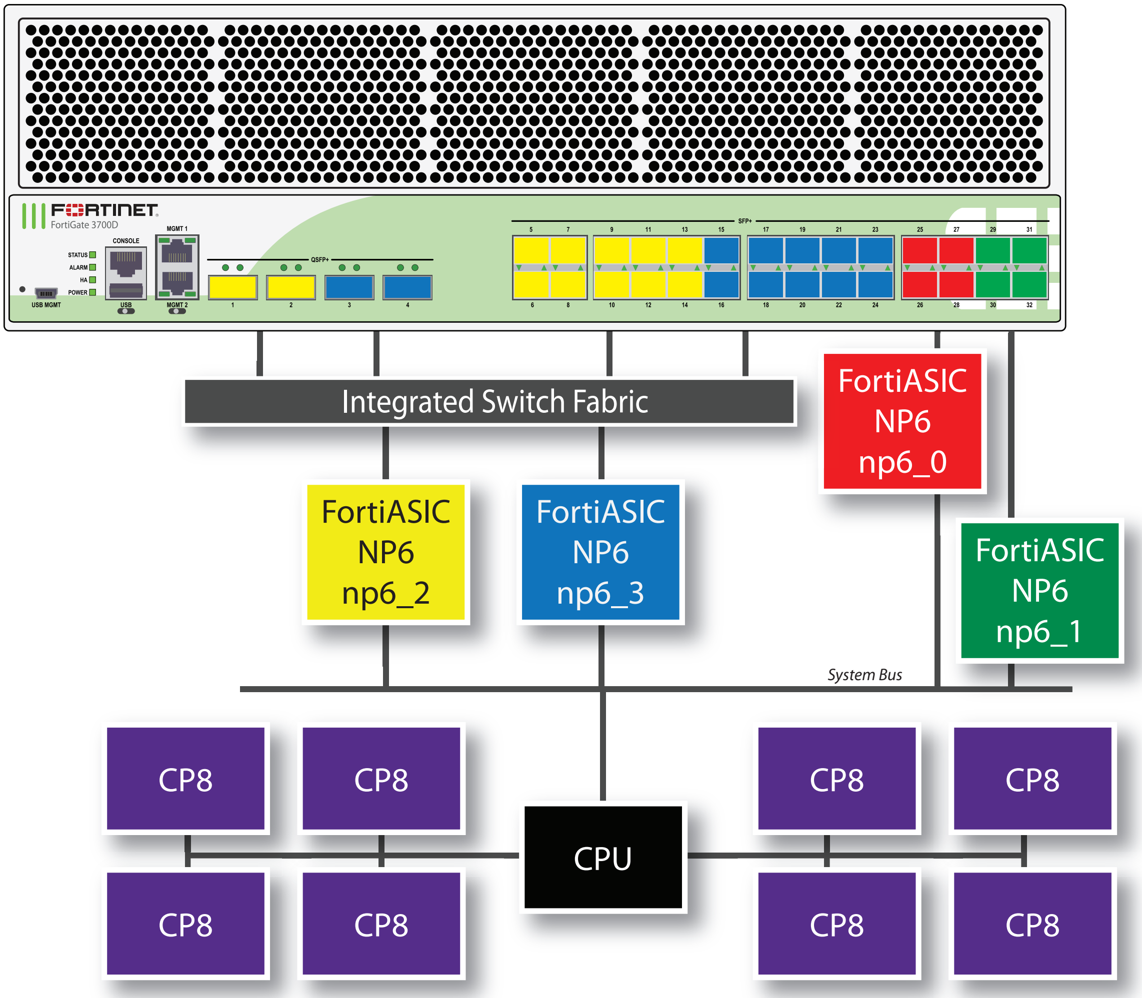
You can use the following command to turn on low latency mode for np6_0 and np6_1:

```
config system np6
  edit np6_0
     set low-latency-mode enable
  next
  edit np6_1
     set low-latency-mode enable
  end
```

You do not have to turn on low latency to both np6_0 and np6_1. If you turn on low latency for just one NP6, the other NP6 will still be mapped according to the normal latency configuration.

With low latency enabled for both np6_0 and np6_1 the FortiGate-3700D has the following fastpath architecture:

- Four SFP+ 10Gb interfaces, port25 to port28, share connections to the first NP6 processor (np6_0) so sessions entering one of these ports and exiting through another will experience low latency
- Four SFP+ 10Gb interfaces, port29 to port32, share connections to the second NP6 processor (np6_1) so sessions entering one of these ports and exiting through another will experience low latency
- Ten SFP+ 10Gb interfaces, port5 to port14, and two 40Gb QSFP interfaces, port1 and port2, share connections to the third NP6 processor (np6_2).
- Ten SFP+ 10Gb interfaces, port15 to port24, and two 40Gb QSFP interfaces, port3 and port4, share connections to the fourth NP6 processor (np6_3).



You can use the following get command to display the FortiGate-3700D NP6 configuration. In this output example, the first two NP6s (np6_0 and np6_1) are configured for low latency. The command output shows four NP6s named NP6_0, NP6_1, NP6_2, and NP6_3 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_2  0    port5   10G   Yes
       0    port9   10G   Yes
       0    port13  10G   Yes
       1    port6   10G   Yes
       1    port10  10G   Yes
       1    port14  10G   Yes
       2    port7   10G   Yes
       2    port11  10G   Yes
       3    port8   10G   Yes
       3    port12  10G   Yes
       0-3  port1   40G   Yes
```

```
        0-3  port2   40G   Yes
------ ---- ------- ----- ----------
np6_3  0    port15  10G   Yes
       0    port19  10G   Yes
       0    port23  10G   Yes
       1    port16  10G   Yes
       1    port20  10G   Yes
       1    port24  10G   Yes
       2    port17  10G   Yes
       2    port21  10G   Yes
       3    port18  10G   Yes
       3    port22  10G   Yes
       0-3  port3   40G   Yes
       0-3  port4   40G   Yes
------ ---- ------- ----- ----------
np6_0  0    port26  10G   No
       1    port25  10G   No
       2    port28  10G   No
       3    port27  10G   No
------ ---- ------- ----- ----------
np6_1  0    port30  10G   No
       1    port29  10G   No
       2    port32  10G   No
       3    port31  10G   No
------ ---- ------- ----- ----------
```

FortiGate-3700D normal latency fast path architecture

You can use the following command to turn off low latency mode for np6_0 and np6_1:

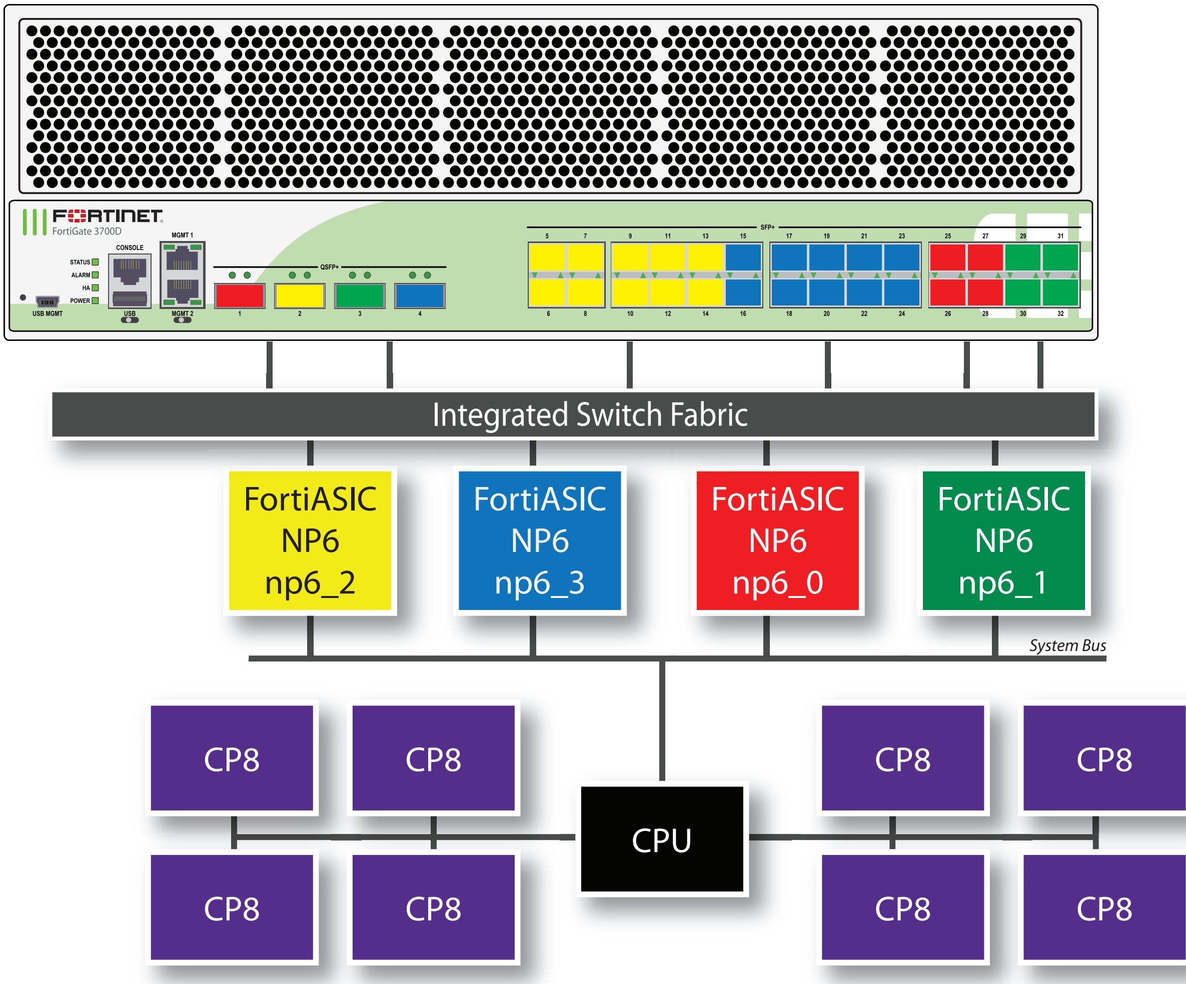
```
config system np6
   edit np6_0
      set low-latency-mode disable
   next
   edit np6_1
      set low-latency-mode disable
   end
```

You do not have to turn off low latency to both np6_0 and np6_1. If you turn off low latency to just one NP6, the other NP6 will still be mapped according to the normal configuration.

In addition to turning off low latency, entering these commands also changes how ports are mapped to NP6s. Port1 is now mapped to np6_0 and port 3 is not mapped to np6_1. The FortiGate-3700D has the following fastpath architecture:

- One 40Gb QSFP interface, port1, and four SFP+ 10Gb interfaces, port25 to port28 share connections to the first NP6 processor (np6_0).
- One 40Gb QSFP interface, port3, and four SFP+ 10Gb interfaces, port29 to port32 share connections to the second NP6 processor (np6_1).
- One 40Gb QSFP interface, port2 and ten SFP+ 10Gb interfaces, port5 to port14 share connections to the third NP6 processor (np6_2).

- One 40Gb QSFP interface, port4, and ten SFP+ 10Gb interfaces, port15 to port24 share connections to the fourth NP6 processor (np6_3).



You can use the following get command to display the FortiGate-3700D NP6 configuration with low latency turned off for np6_0 and np6_1. The command output shows four NP6s named NP6_0, NP6_1, NP6_2, and NP6_3 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6_0  0    port26           10G   Yes
       1    port25           10G   Yes
       2    port28           10G   Yes
       3    port27           10G   Yes
       0-3  port1            40G   Yes
------ ---- -------          ----- ----------
np6_1  0    port30           10G   Yes
       1    port29           10G   Yes
       2    port32           10G   Yes
```

```
       3    port31         10G   Yes
       0-3  port3          40G   Yes
------ ---- -------        ----- ----------
np6_2  0    port5          10G   Yes
       0    port9          10G   Yes
       0    port13         10G   Yes
       1    port6          10G   Yes
       1    port10         10G   Yes
       1    port14         10G   Yes
       2    port7          10G   Yes
       2    port11         10G   Yes
       3    port8          10G   Yes
       3    port12         10G   Yes
       0-3  port2          40G   Yes
------ ---- -------        ----- ----------
np6_3  0    port15         10G   Yes
       0    port19         10G   Yes
       0    port23         10G   Yes
       1    port16         10G   Yes
       1    port20         10G   Yes
       1    port24         10G   Yes
       2    port17         10G   Yes
       2    port21         10G   Yes
       3    port18         10G   Yes
       3    port22         10G   Yes
       0-3  port4          40G   Yes
------ ---- -------        ----- ----------
```

FortiGate-3700DX fast path architecture

The FortiGate-3700DX features four NP6 processors.The first two NP6 processors (np6_0 and np6_1) can be configured for low latency operation. The low latency configuration changes the FortiGate-3700D fast path architecture. The FortiGate-3700DX also includes two TP2 cards that offload GTPu sessions.

FortiGate-3700DX low latency fast path architecture

Ports 25 to 32 can be used for low latency offloading. As long as traffic enters and exits the FortiGate-3700D through ports connected to the same NP6 processor and using these low latency ports the traffic will be offloaded and have lower latency that other NP6 offloaded traffic. Latency is reduced by bypassing the integrated switch fabric (ISF).

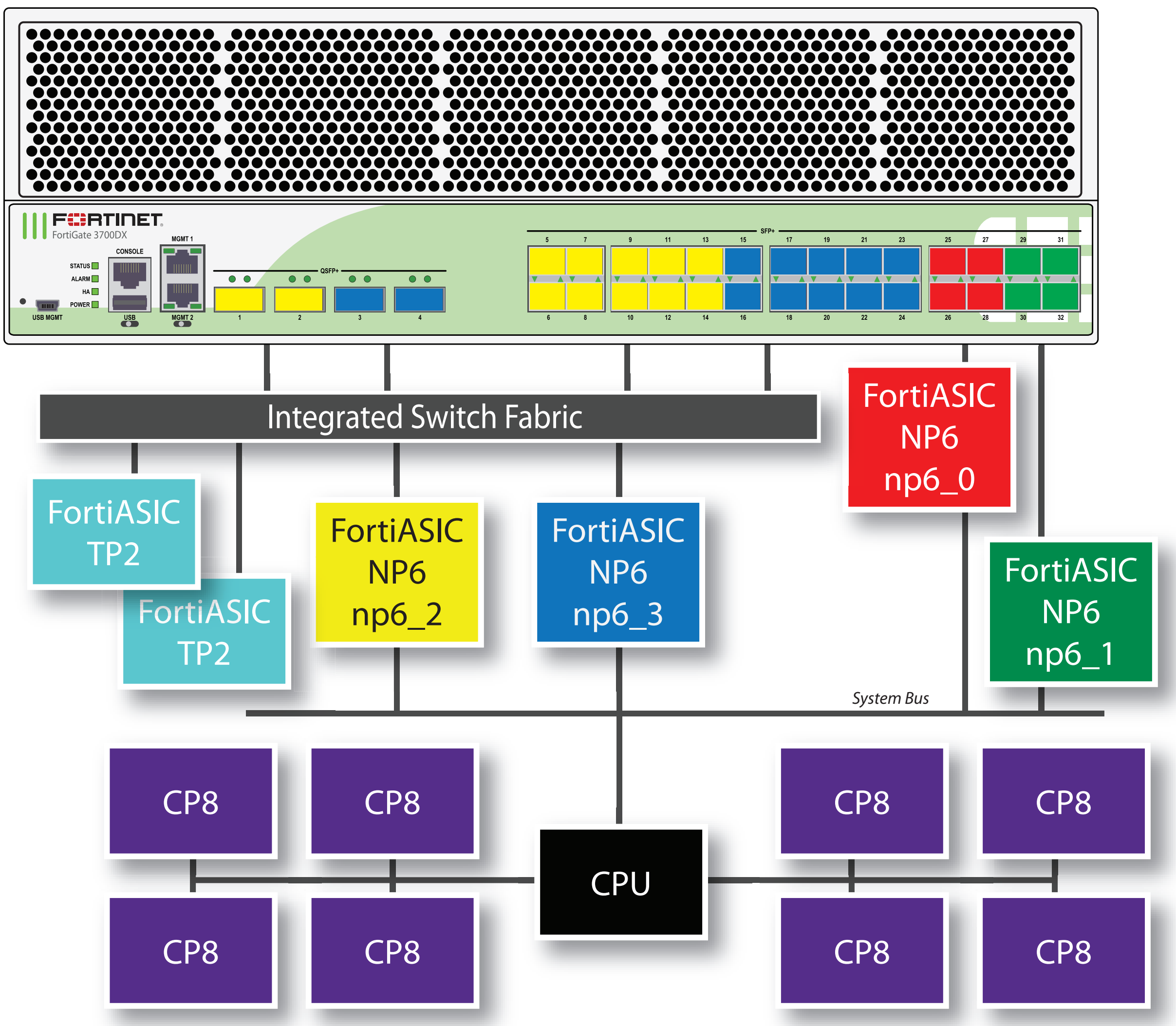
You can use the following command to turn on low latency mode for np6_0 and np6_1:

```
config system np6
  edit np6_0
    set low-latency-mode enable
  next
  edit np6_1
    set low-latency-mode enable
  end
```

You do not have to turn on low latency to both np6_0 and np6_1. If you turn on low latency for just one NP6, the other NP6 will still be mapped according to the normal latency configuration.

With low latency enabled for both np6_0 and np6_1 the FortiGate-3700D has the following fastpath architecture:

- Four SFP+ 10Gb interfaces, port25 to port28, share connections to the first NP6 processor (np6_0) so sessions entering one of these ports and exiting through another will experience low latency
- Four SFP+ 10Gb interfaces, port29 to port32, share connections to the second NP6 processor (np6_1) so sessions entering one of these ports and exiting through another will experience low latency
- Ten SFP+ 10Gb interfaces, port5 to port14, and two 40Gb QSFP interfaces, port1 and port2, share connections to the third NP6 processor (np6_2).
- Ten SFP+ 10Gb interfaces, port15 to port24, and two 40Gb QSFP interfaces, port3 and port4, share connections to the fourth NP6 processor (np6_3).



You can use the following get command to display the FortiGate-3700D NP6 configuration. In this output example, the first two NP6s (np6_0 and np6_1) are configured for low latency. The command output shows four

NP6s named NP6_0, NP6_1, NP6_2, and NP6_3 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max   Cross-chip
                    Speed offloading
------ ---- ------- ----- ----------
np6_2  0    port5   10G   Yes
       0    port9   10G   Yes
       0    port13  10G   Yes
       1    port6   10G   Yes
       1    port10  10G   Yes
       1    port14  10G   Yes
       2    port7   10G   Yes
       2    port11  10G   Yes
       3    port8   10G   Yes
       3    port12  10G   Yes
       0-3  port1   40G   Yes
       0-3  port2   40G   Yes
------ ---- ------- ----- ----------
np6_3  0    port15  10G   Yes
       0    port19  10G   Yes
       0    port23  10G   Yes
       1    port16  10G   Yes
       1    port20  10G   Yes
       1    port24  10G   Yes
       2    port17  10G   Yes
       2    port21  10G   Yes
       3    port18  10G   Yes
       3    port22  10G   Yes
       0-3  port3   40G   Yes
       0-3  port4   40G   Yes
------ ---- ------- ----- ----------
np6_0  0    port26  10G   No
       1    port25  10G   No
       2    port28  10G   No
       3    port27  10G   No
------ ---- ------- ----- ----------
np6_1  0    port30  10G   No
       1    port29  10G   No
       2    port32  10G   No
       3    port31  10G   No
------ ---- ------- ----- ----------
```

FortiGate-3700D normal latency fast path architecture

You can use the following command to turn off low latency mode for np6_0 and np6_1:

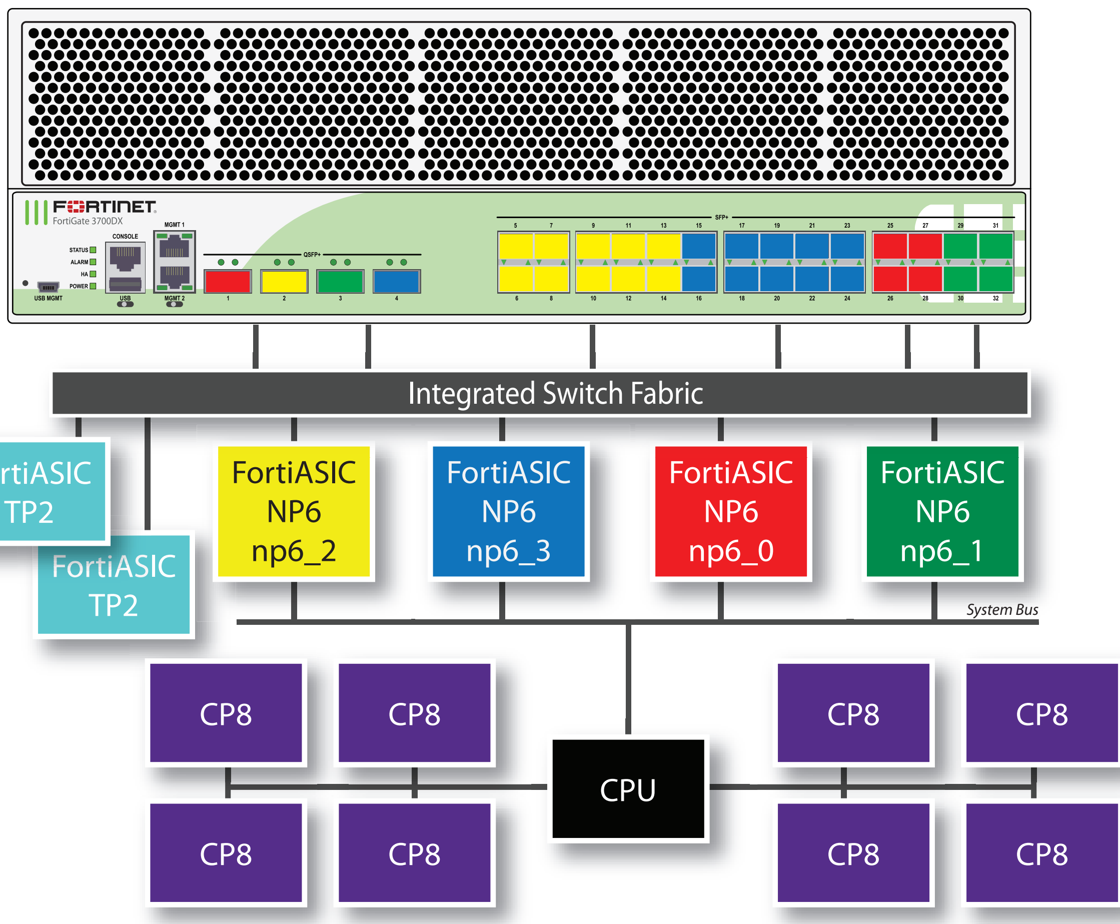
```
config system np6
   edit np6_0
      set low-latency-mode disable
   next
   edit np6_1
      set low-latency-mode disable
```

```
end
```

You do not have to turn off low latency to both np6_0 and np6_1. If you turn off low latency to just one NP6, the other NP6 will still be mapped according to the normal configuration.

In addition to turning off low latency, entering these commands also changes how ports are mapped to NP6s. Port1 is now mapped to np6_0 and port 3 is not mapped to np6_1. The FortiGate-3700D has the following fastpath architecture:

- One 40Gb QSFP interface, port1, and four SFP+ 10Gb interfaces, port25 to port28 share connections to the first NP6 processor (np6_0).
- One 40Gb QSFP interface, port3, and four SFP+ 10Gb interfaces, port29 to port32 share connections to the second NP6 processor (np6_1).
- One 40Gb QSFP interface, port2 and ten SFP+ 10Gb interfaces, port5 to port14 share connections to the third NP6 processor (np6_2).
- One 40Gb QSFP interface, port4, and ten SFP+ 10Gb interfaces, port15 to port24 share connections to the fourth NP6 processor (np6_3).



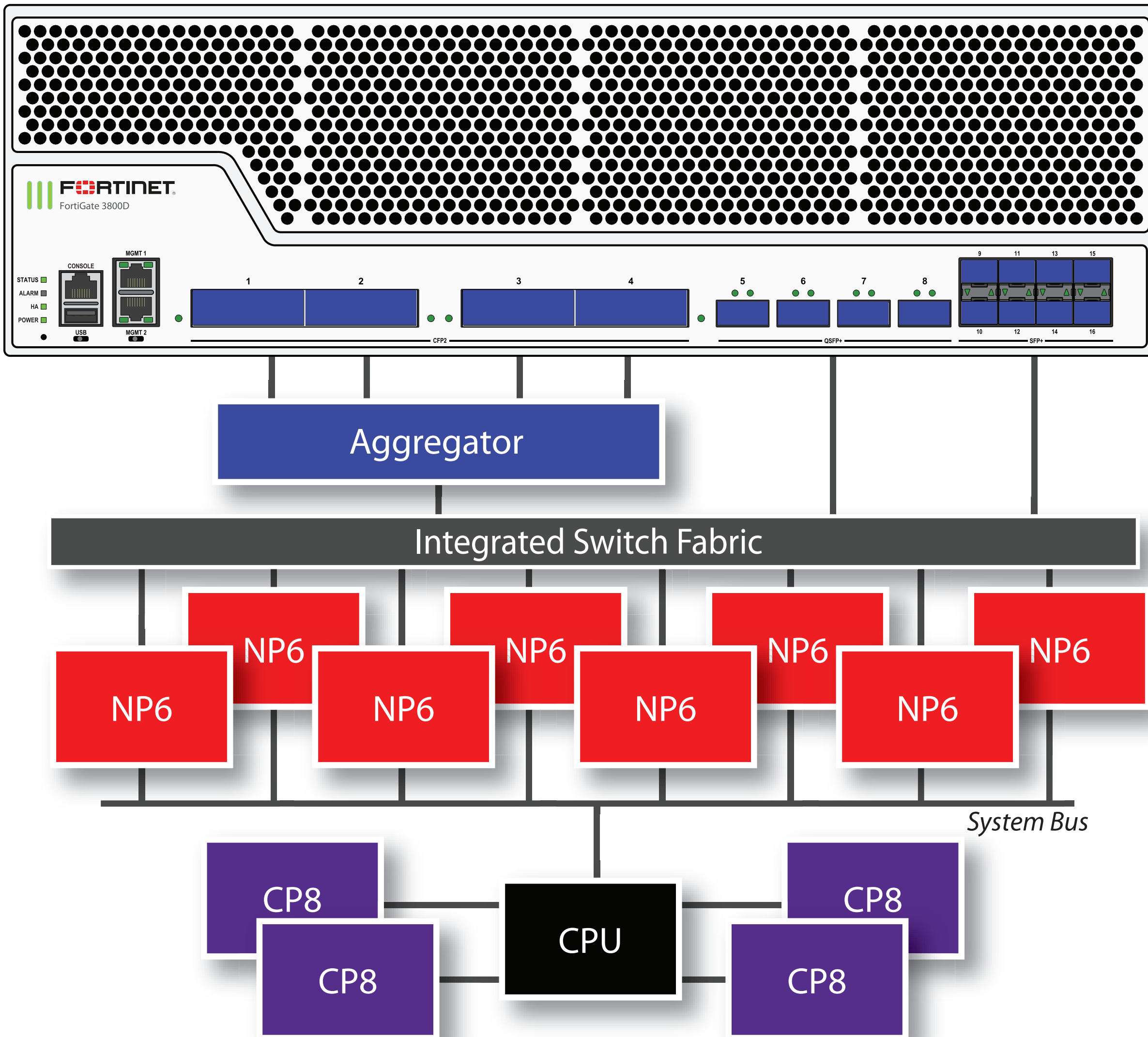
You can use the following get command to display the FortiGate-3700D NP6 configuration with low latency turned off for np6_0 and np6_1. The command output shows four NP6s named NP6_0, NP6_1, NP6_2, and

NP6_3 and the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6_0  0    port26           10G   Yes
       1    port25           10G   Yes
       2    port28           10G   Yes
       3    port27           10G   Yes
       0-3  port1            40G   Yes
------ ---- -------          ----- ----------
np6_1  0    port30           10G   Yes
       1    port29           10G   Yes
       2    port32           10G   Yes
       3    port31           10G   Yes
       0-3  port3            40G   Yes
------ ---- -------          ----- ----------
np6_2  0    port5            10G   Yes
       0    port9            10G   Yes
       0    port13           10G   Yes
       1    port6            10G   Yes
       1    port10           10G   Yes
       1    port14           10G   Yes
       2    port7            10G   Yes
       2    port11           10G   Yes
       3    port8            10G   Yes
       3    port12           10G   Yes
       0-3  port2            40G   Yes
------ ---- -------          ----- ----------
np6_3  0    port15           10G   Yes
       0    port19           10G   Yes
       0    port23           10G   Yes
       1    port16           10G   Yes
       1    port20           10G   Yes
       1    port24           10G   Yes
       2    port17           10G   Yes
       2    port21           10G   Yes
       3    port18           10G   Yes
       3    port22           10G   Yes
       0-3  port4            40G   Yes
------ ---- -------          ----- ----------
```

FortiGate-3800D fast path architecture

The FortiGate-3800D features four front panel 100GigE CFP2 interfaces, four 40GigE QSFP+ interfaces, and eight 10GigE SFP+ interfaces connected to eight NP6 processors through an Integrated Switch Fabric (ISF). Individual interfaces are not mapped to NP6 processors because of the integrated switch fabric. No special mapping is required for fastpath offloading or aggregate interfaces.



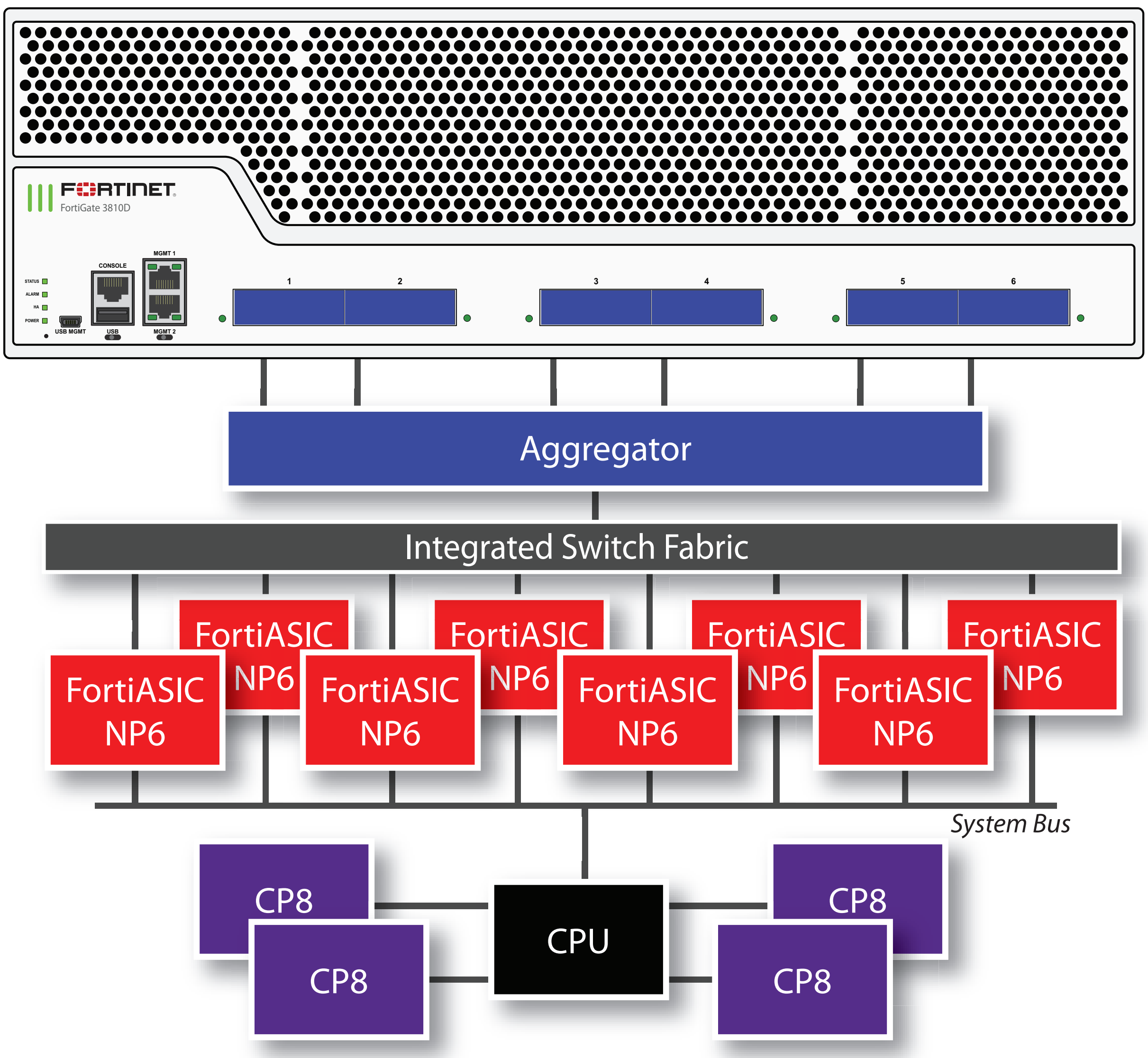
You can use the following get command to display the FortiGate-3800D NP6 configuration. The command output shows all NP6s connected to each interface (port) with cross-chip offloading supported for each port. You can also use the `diagnose npu np6 port-list` command to display this information.

```
Chip                 XAUI Ports   Max    Cross-chip
                                  Speed  offloading
------               ---- ------- ------ ----------
NP#0-7               0-3  port1   100000M Yes
NP#0-7               0-3  port2   100000M Yes
NP#0-7               0-3  port3   100000M Yes
NP#0-7               0-3  port4   100000M Yes
NP#0-7               0-3  port5   40000M  Yes
NP#0-7               0-3  port6   40000M  Yes
NP#0-7               0-3  port7   40000M  Yes
NP#0-7               0-3  port8   40000M  Yes
NP#0-7               0-3  port9   10000M  Yes
NP#0-7               0-3  port10  10000M  Yes
```

```
NP#0-7              0-3  port11  10000M  Yes
NP#0-7              0-3  port12  10000M  Yes
NP#0-7              0-3  port13  10000M  Yes
NP#0-7              0-3  port14  10000M  Yes
NP#0-7              0-3  port15  10000M  Yes
NP#0-7              0-3  port16  10000M  Yes
------              ---- ------- ------  ----------
```

FortiGate-3810D fast path architecture

The FortiGate-3810D features six front panel 100GigE CFP2 interfaces connected to eight NP6 processors through an Integrated Switch Fabric (ISF). Individual interfaces are not mapped to NP6 processors because of the integrated switch fabric. No special mapping is required for fastpath offloading or aggregate interfaces.

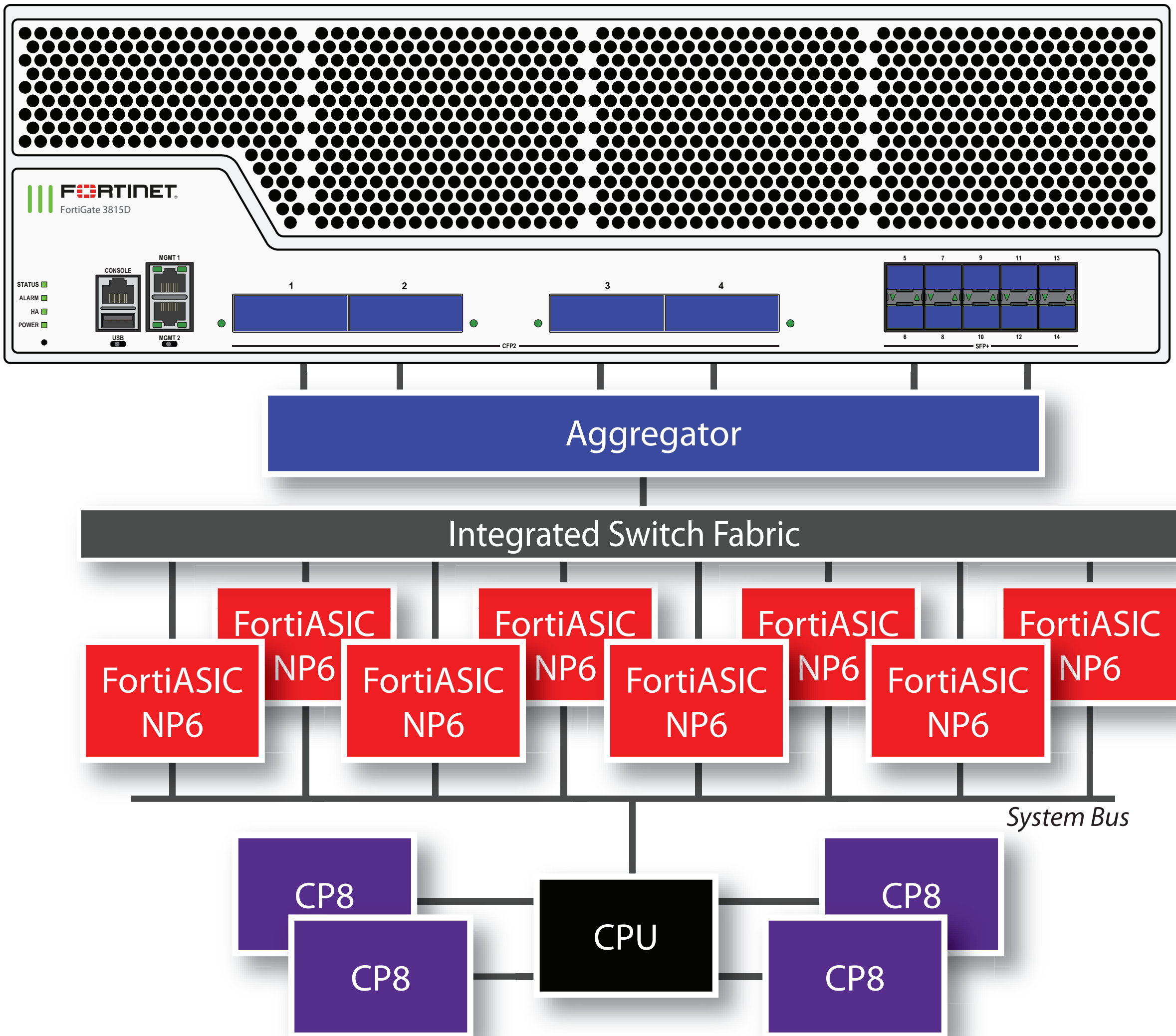


You can use the following get command to display the FortiGate-3810D NP6 configuration. The command output shows all NP6s connected to each interface (port) with cross-chip offloading supported for each port. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max     Cross-chip
                    Speed   offloading
------ ---- ------- ------  ----------
all    0-3  port1   100000M Yes
all    0-3  port2   100000M Yes
all    0-3  port3   100000M Yes
all    0-3  port4   100000M Yes
all    0-3  port5   100000M Yes
all    0-3  port6   100000M Yes
------ ---- ------- ------  ----------
```

FortiGate-3815D fast path architecture

The FortiGate-3815D features four front panel 100GigE CFP2 interfaces and eight 10GigE SFP+ interfaces connected to eight NP6 processors through an Integrated Switch Fabric (ISF). Individual interfaces are not mapped to NP6 processors because of the integrated switch fabric. No special mapping is required for fastpath offloading or aggregate interfaces.



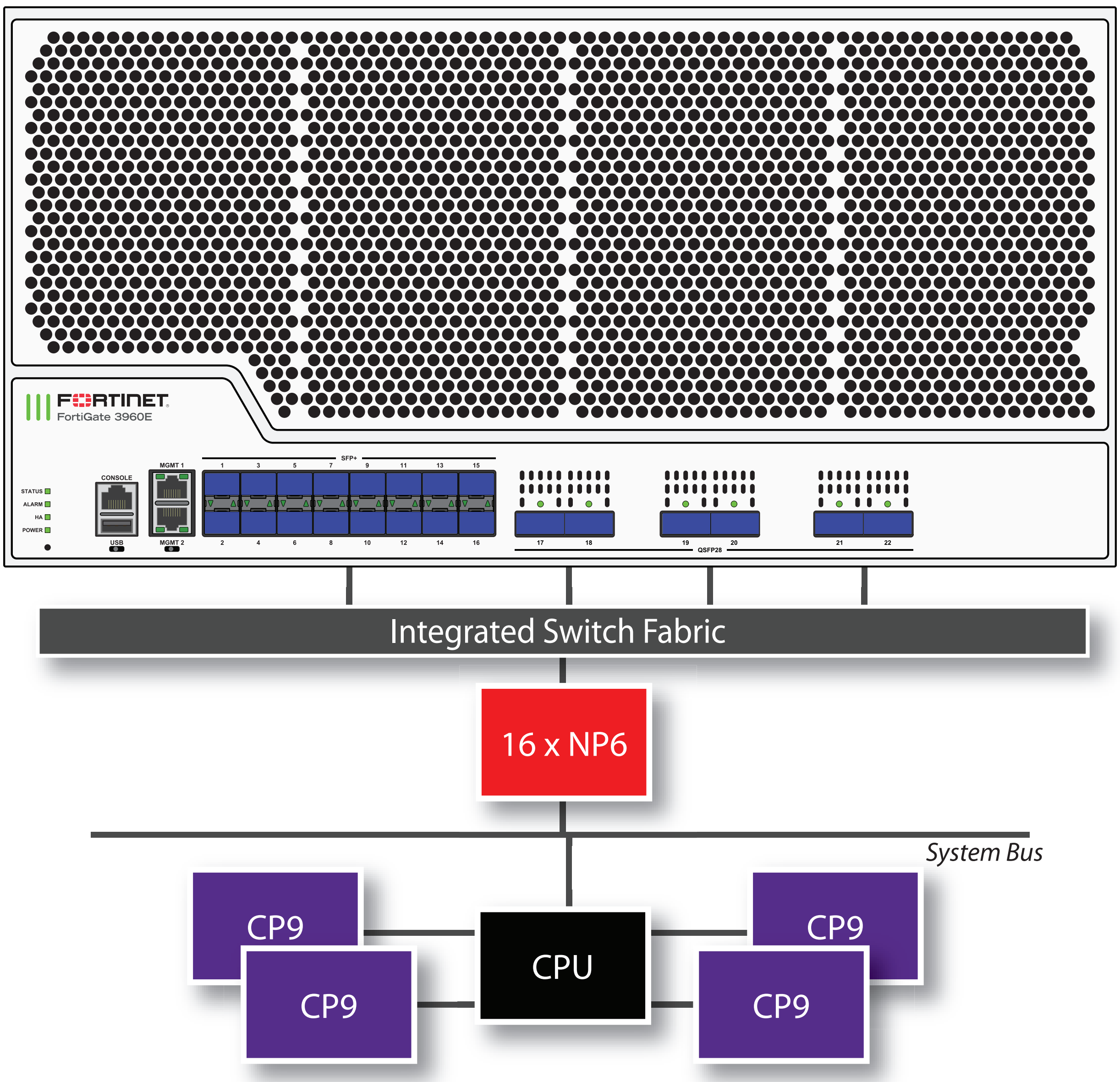
You can use the following get command to display the FortiGate-3815D NP6 configuration. The command output shows all NP6s connected to each interface (port) with cross-chip offloading supported for each port. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max     Cross-chip
                    Speed   offloading
------ ---- ------- ------  ----------
all    0-3  port1   100000M Yes
all    0-3  port2   100000M Yes
all    0-3  port3   100000M Yes
all    0-3  port4   100000M Yes
all    0-3  port11  10000M  Yes
all    0-3  port12  10000M  Yes
all    0-3  port13  10000M  Yes
all    0-3  port14  10000M  Yes
all    0-3  port10  10000M  Yes
```

```
all     0-3   port9    10000M   Yes
all     0-3   port8    10000M   Yes
all     0-3   port7    10000M   Yes
all     0-3   port5    10000M   Yes
all     0-3   port6    10000M   Yes
```

FortiGate-3960E fast path architecture

The FortiGate-3960E features sixteen front panel 10GigE SFP+ interfaces and six 100GigE QSFP+ interfaces connected to sixteen NP6 processors through an Integrated Switch Fabric (ISF). Individual interfaces are not mapped to NP6 processors because of the integrated switch fabric. No special mapping is required for fastpath offloading or aggregate interfaces.

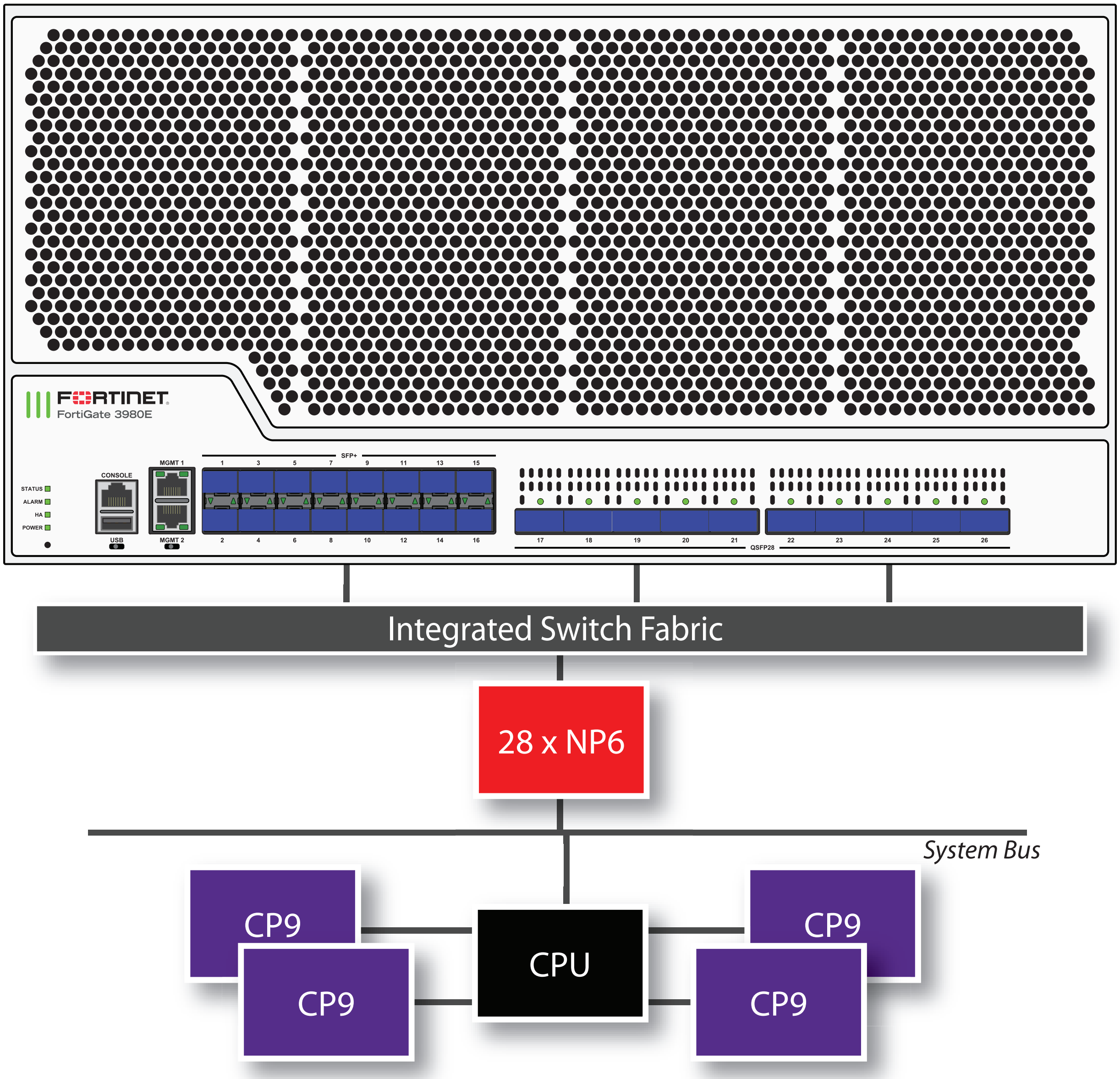


You can use the following get command to display the FortiGate-3960E NP6 configuration. The command output shows all NP6s connected to each interface (port) with cross-chip offloading supported for each port. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports   Max    Cross-chip
                    Speed  offloading
------ ---- ------- ------  ----------
NP#0-7              0-3  port1   10000M  Yes
NP#2                0-3  port2   10000M  Yes
NP#0-7              0-3  port3   10000M  Yes
NP#0-7              0-3  port4   10000M  Yes
NP#0-7              0-3  port5   10000M  Yes
NP#0-7              0-3  port6   10000M  Yes
NP#0-7              0-3  port7   10000M  Yes
NP#0-7              0-3  port8   10000M  Yes
NP#0-7              0-3  port9   10000M  Yes
NP#0-7              0-3  port10  10000M  Yes
NP#0-7              0-3  port11  10000M  Yes
NP#0-7              0-3  port12  10000M  Yes
NP#0-7              0-3  port13  10000M  Yes
NP#0-7              0-3  port14  10000M  Yes
NP#0-7              0-3  port15  10000M  Yes
NP#0-7              0-3  port16  10000M  Yes
NP#7                0-3  port17  100000M Yes
NP#0-7              0-3  port18  100000M Yes
NP#10               0-3  port19  100000M Yes
NP#12-15            0-3  port20  100000M Yes
NP#8-15             0-3  port21  100000M Yes
NP#8-15             0-3  port22  100000M Yes
------ ---- ------- ------  ----------
```

FortiGate-3980E fast path architecture

The FortiGate-3980E features sixteen front panel 10GigE SFP+ interfaces and ten 100GigE QSFP28 interfaces connected to twenty-eight NP6 processors through an Integrated Switch Fabric (ISF). Individual interfaces are not mapped to NP6 processors because of the integrated switch fabric. No special mapping is required for fastpath offloading or aggregate interfaces.



You can use the following get command to display the FortiGate-3980E NP6 configuration. The command output shows all NP6s connected to each interface (port) with cross-chip offloading supported for each port. You can also use the `diagnose npu np6 port-list` command to display this information.

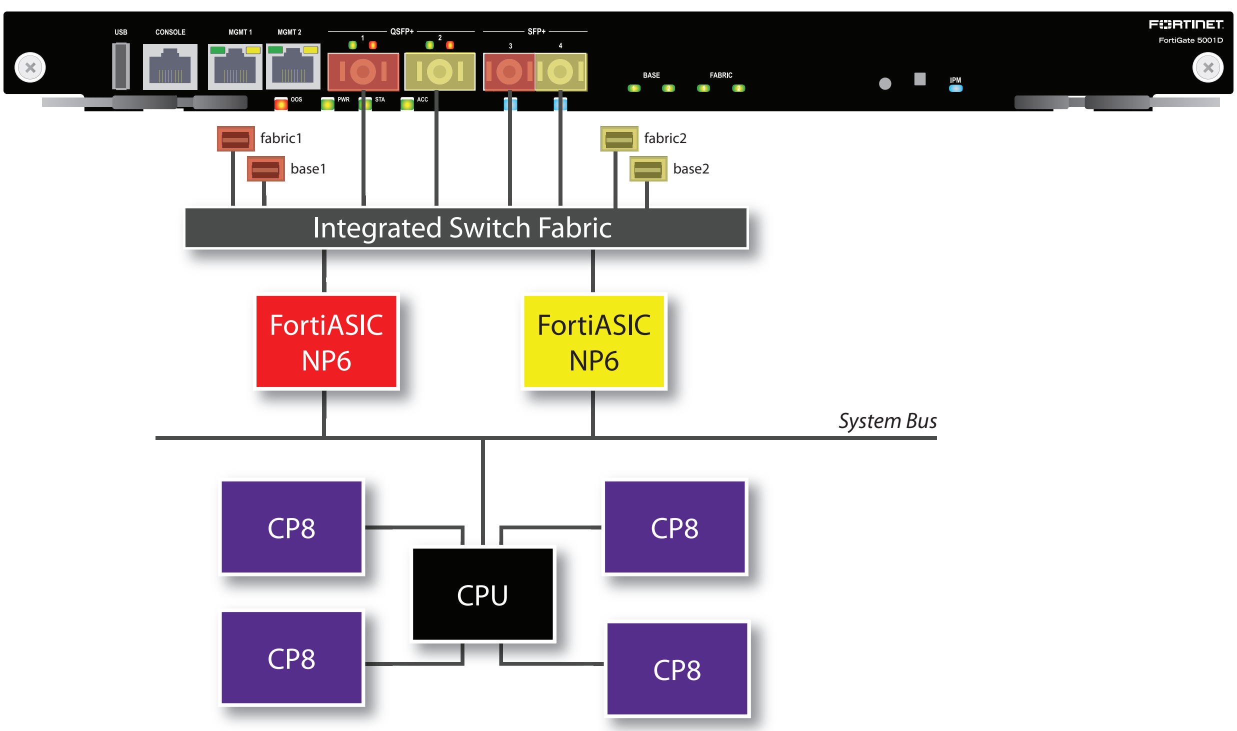
```
diagnose npu np6 port-list
Chip    XAUI Ports    Max    Cross-chip
                      Speed  offloading
------ ---- ------- ------ ----------
NP#0-7              0-3  port1   10000M  Yes
NP#0-7              0-3  port2   10000M  Yes
NP#0-7              0-3  port3   10000M  Yes
NP#0-7              0-3  port4   10000M  Yes
NP#0-7              0-3  port5   10000M  Yes
NP#0-7              0-3  port6   10000M  Yes
NP#0-7              0-3  port7   10000M  Yes
```

```
NP#0-7              0-3  port8   10000M  Yes
NP#0-7              0-3  port9   10000M  Yes
NP#0-7              0-3  port10  10000M  Yes
NP#0-7              0-3  port11  10000M  Yes
NP#0-7              0-3  port12  10000M  Yes
NP#0-7              0-3  port13  10000M  Yes
NP#0-7              0-3  port14  10000M  Yes
NP#0-7              0-3  port15  10000M  Yes
NP#0-7              0-3  port16  10000M  Yes
NP#0-7              0-3  port17  100000M Yes
NP#0-7              0-3  port18  100000M Yes
NP#8-27             0-3  port19  100000M Yes
NP#8-27             0-3  port20  100000M Yes
NP#8-27             0-3  port21  100000M Yes
NP#8-27             0-3  port22  100000M Yes
NP#8-27             0-3  port23  100000M Yes
NP#8-27             0-3  port24  100000M Yes
NP#8-27             0-3  port25  100000M Yes
NP#8-27             0-3  port26  100000M Yes
```

FortiGate-5001D fast path architecture

The FortiGate5001D features two NP6 processors.

- port1, port3, fabric1 and base1 share connections to the first NP6 processor.
- port2, port4, fabric2 and base2 share connections to the second NP6 processor.



NP6 default interface mapping

You can use the following get command to display the FortiGate-5001D NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------

np6_0  0    port3            10G   Yes
       1
       2    base1            1G    Yes
       3
       0-3  port1            40G   Yes
       0-3  fabric1          40G   Yes
       0-3  fabric3          40G   Yes
       0-3  fabric5          40G   Yes
------ ---- -------          ----- ----------
np6_1  0
       1    port4            10G   Yes
       2
       3    base2            1G    Yes
       0-3  port2            40G   Yes
       0-3  fabric2          40G   Yes
       0-3  fabric4          40G   Yes
------ ---- -------          ----- ----------
```

NP6 interface mapping with split ports

If you use the following CLI command to split port1:

```
config system global
   set split-port port1
end
```

The new split ports (port1/1 to port 1/4) are mapped to the same NP6 as the un-split port1 interface:

```
diagnose npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6_0  0    port3            10G   Yes
       0    port1/1          10G   Yes
       1    port1/2          10G   Yes
       2    base1            1G    Yes
       2    port1/3          10G   Yes
       3    port1/4          10G   Yes
       0-3  fabric1          40G   Yes
       0-3  fabric3          40G   Yes
       0-3  fabric5          40G   Yes
------ ---- -------          ----- ----------
np6_1  0
```

```
              1    port4             10G   Yes
              2
              3    base2             1G    Yes
              0-3  port2             40G   Yes
              0-3  fabric2           40G   Yes
              0-3  fabric4           40G   Yes
------ ---- -------           ----- ----------
```

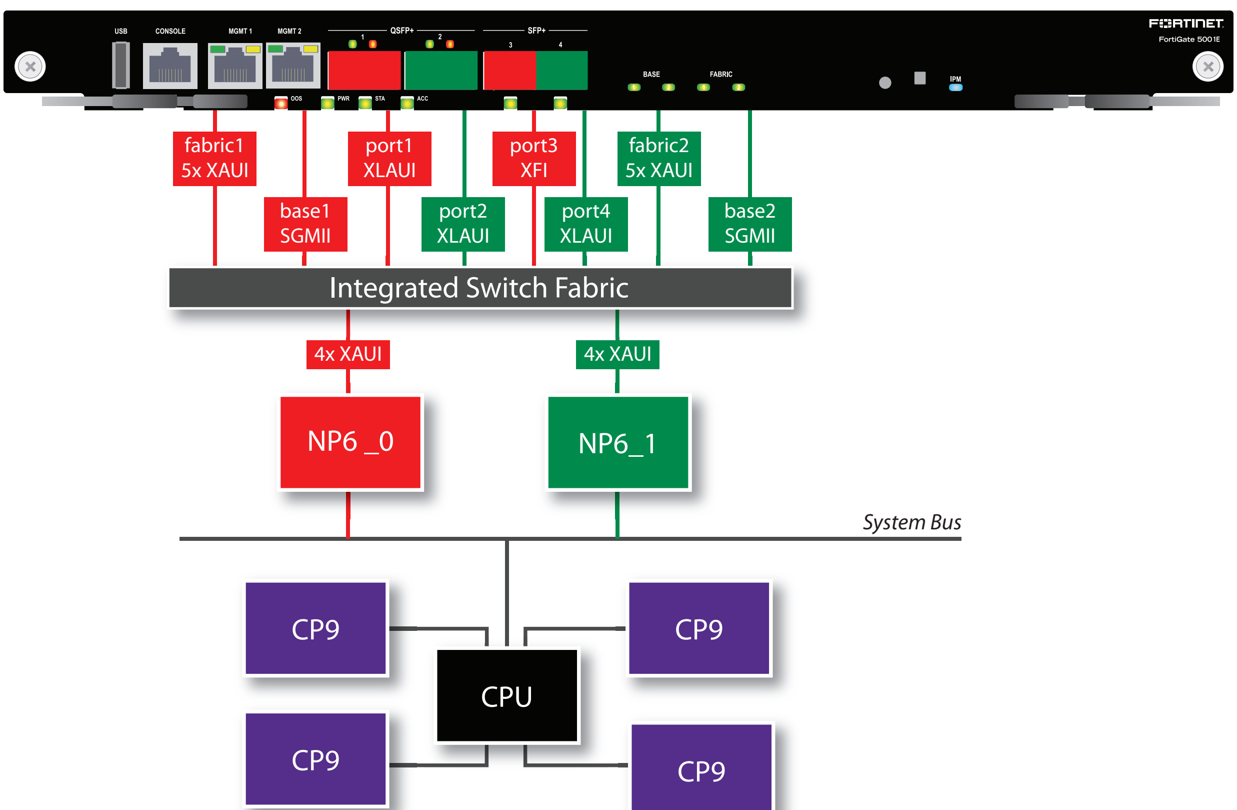
FortiGate-5001E and 5001E1 fast path architecture

The FortiGate-5001E and 5001E1 features two NP6 processors and an integrated switch fabric. The integrated switch fabric allows you to configure aggregate interfaces between interfaces connected to different NP6s and supports offloading between for traffic entering and exiting from any interfaces.

The NP6s are connected to network interfaces as follows:

- NP6_0 is connected to port1, port3, fabric1, and base1.
- NP6_1 is connected to port2, port4, fabric2, and base2.

The following diagram also shows the XAUI port connections between the NP6 processors and the front panel interfaces and the integrated switch fabric.



NP6 default interface mapping

You can use the following get command to display the FortiGate-5001E NP6 configuration. The command output shows two NP6s named NP6_0 and NP6_1. The output also shows the interfaces (ports) connected to each NP6. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------

np6_0  0    port3            10G   Yes
       1
       2    base1            1G    Yes
       3
       0-3  port1            40G   Yes
       0-3  fabric1          40G   Yes
       0-3  fabric3          40G   Yes
       0-3  fabric5          40G   Yes
------ ---- -------          ----- ----------
np6_1  0
       1    port4            10G   Yes
       2
       3    base2            1G    Yes
       0-3  port2            40G   Yes
       0-3  fabric2          40G   Yes
       0-3  fabric4          40G   Yes
------ ---- -------          ----- ----------
```

NP6 interface mapping with split ports

If you use the following CLI command to split port1:

```
config system global
  set split-port port1
end
```

The new split ports (port1/1 to port 1/4) are mapped to the same NP6 as the un-split port1 interface:

```
diagnose npu np6 port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6_0  0    port3            10G   Yes
       0    port1/1          10G   Yes
       1    port1/2          10G   Yes
       2    base1            1G    Yes
       2    port1/3          10G   Yes
       3    port1/4          10G   Yes
       0-3  fabric1          40G   Yes
       0-3  fabric3          40G   Yes
       0-3  fabric5          40G   Yes
------ ---- -------          ----- ----------
np6_1  0
```

```
        1    port4           10G   Yes
        2
        3    base2           1G    Yes
        0-3  port2           40G   Yes
        0-3  fabric2         40G   Yes
        0-3  fabric4         40G   Yes
------ ---- -------         ----- ----------
```

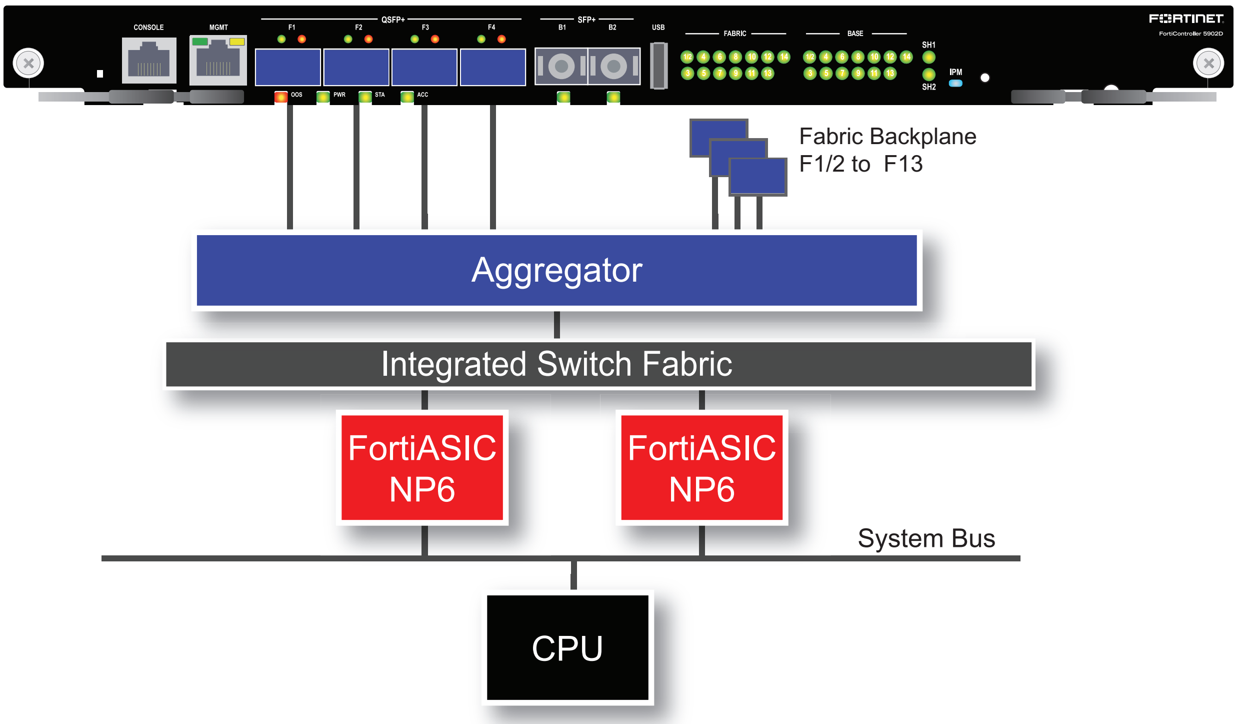
FortiController-5902D fast path architecture

The FortiController-5902D NP6 network processors and integrated switch fabric (ISF) provide hardware acceleration by offloading load balancing from the primary FortiController-5902D CPU. Network processors are especially useful for accelerating load balancing of TCP and UDP sessions.

The first packet of every new session is received by the primary FortiController-5902D and the primary FortiController-5902D uses its load balancing schedule to select the worker that will process the new session. This information is passed back to an NP6 network processor and all subsequent packets of the same sessions are offloaded to an NP6 network processor which sends the packet directly to a subordinate unit. Load balancing is effectively offloaded from the primary unit to the NP6 network processors resulting in a faster and more stable active-active cluster.

Traffic accepted by the FortiController-5902D F1 to F4 interfaces is that is processed by the primary FortiController-5902D is also be offloaded to the NP6 processors.

Individual FortiController-5902D interfaces are not mapped to NP6 processors. Instead an Aggregator connects the all fabric interfaces to the ISF and no special mapping is required for fastpath offloading.



NP6 content clustering mode interface mapping

FortiController-5902Ds run in content clustering mode and load balance sessions to FortiGate-5001D workers. Use the following command to enable content clustering:

```
config system elbc
   set mode content-cluster
   set inter-chassis-support enable
end
```

You can use the following get command to display the content clustering FortiController-5902D NP6 configuration. The output shows that all ports are mapped to all NP6 processors. You can also use the `diagnose npu np6 port-list` command to display this information.

```
get hardware npu np6 port-list

Chip   XAUI Ports          Max    Cross-chip
                           Speed  offloading
------ ---- ----------     ------ ----------
all    0-3  f1             40000M Yes
all    0-3  f2             40000M Yes
all    0-3  f3             40000M Yes
all    0-3  f4             40000M Yes
all    0-3  np6_0_4        10000M Yes
all    0-3  np6_0_5        10000M Yes
all    0-3  elbc-ctrl/1-2  40000M Yes
all    0-3  elbc-ctrl/3    40000M Yes
all    0-3  elbc-ctrl/4    40000M Yes
all    0-3  elbc-ctrl/5    40000M Yes
all    0-3  elbc-ctrl/6    40000M Yes
```

```
all    0-3  elbc-ctrl/7    40000M  Yes
all    0-3  elbc-ctrl/8    40000M  Yes
all    0-3  elbc-ctrl/9    40000M  Yes
all    0-3  elbc-ctrl/10   40000M  Yes
all    0-3  elbc-ctrl/11   40000M  Yes
all    0-3  elbc-ctrl/12   40000M  Yes
all    0-3  elbc-ctrl/13   40000M  Yes
all    0-3  elbc-ctrl/14   40000M  Yes
------ ---- ----------     ------  ----------
```

NP6 default interface mapping

You can use the following command to display the default FortiController-5902D NP6 configuration.

```
diagnose npu np6 port-list

Chip   XAUI Ports        Max     Cross-chip
                         Speed   offloading
------ ---- ----------   ------  ----------
all    0-3  f1           40000M  Yes
all    0-3  f2           40000M  Yes
all    0-3  f3           40000M  Yes
all    0-3  f4           40000M  Yes
all    0-3  np6_0_4      10000M  Yes
all    0-3  np6_0_5      10000M  Yes
all    0-3  fabric1/2    40000M  Yes
all    0-3  fabric3      40000M  Yes
all    0-3  fabric4      40000M  Yes
all    0-3  fabric5      40000M  Yes
all    0-3  fabric6      40000M  Yes
all    0-3  fabric7      40000M  Yes
all    0-3  fabric8      40000M  Yes
all    0-3  fabric9      40000M  Yes
all    0-3  fabric10     40000M  Yes
all    0-3  fabric11     40000M  Yes
all    0-3  fabric12     40000M  Yes
all    0-3  fabric13     40000M  Yes
all    0-3  fabric14     40000M  Yes
```

FortiGate NP6lite architectures

This chapter shows the NP6lite architecture for the all FortiGate models that include NP6lite processors.

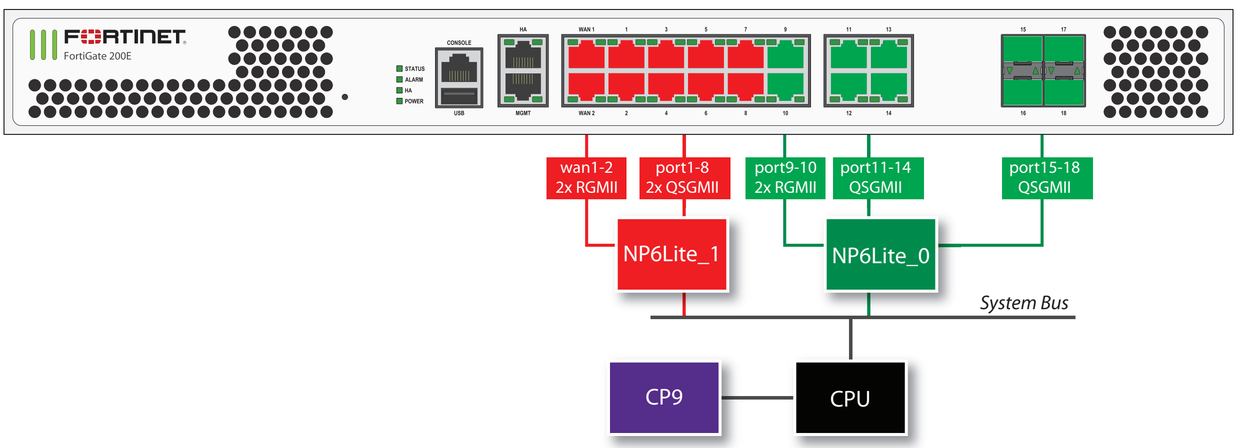
FortiGate-200E and 201E fast path architecture

The FortiGate-200E and 201E include two NP6lite processors. Because of this model does not include a switch fabric, you cannot create Link Aggregation Groups (LAGs) or redundant interfaces between interfaces connected to different NP6lites. As well traffic will only be offloaded if it enters and exits the FortiGate on interfaces connected to the same NP6lite.

The NP6lites are connected to network interfaces as follows:

- NP6lite_0 is connected to six 1GE RJ-45 interfaces (port9-port14) and four 1GE SFP interfaces (port15-18).
- NP6lite_1 is connected to ten 1GE RJ45 interfaces (wan1, wan2, port1-port8).

The following diagram also shows the RGMII and QSGMII port connections between the NP6lite processors and the front panel interfaces. Both RGMII and QSGMII interfaces operate at 1000Mbps. However, QSGMII interfaces can also negotiate to operate at lower speeds: 10, 100, and 1000Mbps. To connect the FortiGate-200E to networks with speeds lower than 1000Mbps use the QSGMII interfaces (port1-8 and port11-18).



You can use the following get command to display the FortiGate-200E or 201E NP6lite configuration. You can also use the `diagnose npu np6lite port-list` command to display this information.

```
get hardware npu np6lite port-list
Chip   XAUI Ports            Max   Cross-chip
                             Speed offloading
------ ---- -------          ----- ----------
np6lite_0
       2    port9            1000M          NO
       1    port10           1000M          NO
       4    port11           1000M          NO
       3    port12           1000M          NO
       6    port13           1000M          NO
       5    port14           1000M          NO
       9    port15           1000M          NO
       10   port16           1000M          NO
       8    port17           1000M          NO
       7    port18           1000M          NO
np6lite_1
       2    wan1             1000M          NO
       1    wan2             1000M          NO
       4    port1            1000M          NO
       3    port2            1000M          NO
       6    port3            1000M          NO
       5    port4            1000M          NO
       8    port5            1000M          NO
       7    port6            1000M          NO
       10   port7            1000M          NO
       9    port8            1000M          NO
```

NP4 and NP4Lite Acceleration

NP4 network processors provide fastpath acceleration by offloading communication sessions from the FortiGate CPU. When the first packet of a new session is received by an interface connected to an NP4 processor, just like any session connecting with any FortiGate interface, the session is forwarded to the FortiGate CPU where it is matched with a security policy. If the session is accepted by a security policy and if the session can be offloaded its session key is copied to the NP4 processor that received the packet. All of the rest of the packets in the session are intercepted by the NP4 processor and fast-pathed out of the FortiGate unit to their destination without ever passing through the FortiGate CPU. The result is enhanced network performance provided by the NP4 processor plus the network processing load is removed from the CPU. In addition, the NP4 processor can handle some CPU intensive tasks, like IPsec VPN encryption/decryption.

NP4lite processors have the same architecture and function in the same way as NP4 processors. All of the descriptions of NP4 processors in this document can be applied to NP4lite possessors except where noted.

Session keys (and IPsec SA keys) are stored in the memory of the NP4 processor that is connected to the interface that received the packet that started the session. All sessions are fast-pathed and accelerated, even if they exit the FortiGate unit through an interface connected to another NP4. The key to making this possible is the Integrated Switch Fabric (ISF) that connects the NP4s and the FortiGate unit interfaces together. The ISF allows any port connectivity. All ports and NP4s can communicate with each other over the ISF.

There are no special ingress and egress fast path requirements because traffic enters and exits on interfaces connected to the same ISF. Most FortiGate models with multiple NP4 processors connect all interfaces and NP4 processors to the same ISF (except management interfaces) so this should not ever be a problem.

There is one limitation to keep in mind; the capacity of each NP4 processor. An individual NP4 processor has a capacity of 20 Gbps (10 Gbps ingress and 10 Gbps egress). Once an NP4 processor hits its limit, sessions that are over the limit are sent to the CPU. You can avoid this problem by as much as possible distributing incoming sessions evenly among the NP4 processors. To be able to do this you need to be aware of which interfaces connect to which NP4 processors and distribute incoming traffic accordingly.

Some FortiGate units contain one NP4 processor with all interfaces connected to it and to the ISF. As a result, offloading is supported for traffic between any pair of interfaces.

Some FortiGate units include NP4Lite processors. These network processors have the same functionality and limitations as NP4 processors but with about half the performance. Also, NP4Lite processors do not support traffic shaping for offloaded sessions. NP4lite processors can be found in mid-range FortiGate models such as the FortiGate-200D and 240D.

Viewing your FortiGate's NP4 configuration

To list the NP4 network processors on your FortiGate unit, use the following CLI command.

```
get hardware npu np4 list
```

The output lists the interfaces that have NP4 processors. For example, for a FortiGate-5001C:

```
get hardware npu np4 list
ID    Model          Slot       Interface
```

```
0     On-board                 port1 port2 port3 port4
                               fabric1 base1 npu0-vlink0 npu0-vlink1
1     On-board                 port5 port6 port7 port8
                               fabric2 base2 npu1-vlink0 npu1-vlink1
```

NP4lite CLI commands (disabling NP4Lite offloading)

If your FortiGate unit includes an NP4Lite processor the following commands will be available:

- Use the following command to disable or enable NP4Lite offloading. By default NP4lite offloading is enabled. If you want to disable NP4Lite offloading to diagnose a problem enter:

```
diagnose npu nplite fastpath disable
```

This command disables NP4Lite offloading until your FortiGate reboots. You can also re-enable offloading by entering the following command:

```
diagnose npu nplite fastpath enable
```

- NP4lite debug command. Use the following command to debug NP4Lite operation:

```
diagnose npl npl_debug {<parameters>}
```

NP4Lite option to disable offloading ICMP traffic in IPsec tunnels

In some cases ICMP traffic in IPsec VPN tunnels may be dropped by the NP4Lite processor due to a bug with the NP4Lite firmware. You can use the following command to avoid this problem by preventing the NP4Lite processor from offloading ICMP sessions in IPsec VPN tunnels. This command is only available on FortiGate models with NP4Lite processors, such as the FortiGate/FortiWiFi-60D.

```
config system npu
   set process-icmp-by-host {disable | enable}
end
```

The option is disabled by default an all ICMP traffic in IPsec VPN tunnels is offloaded where possible. If you are noticing that ICMP packets in IPsec VPN tunnels are being dropped you can disable this option and have all ICMP traffic processed by the CPU and not offloaded to the NP4Lite.

NP4 and NP4Lite processors and sFlow and NetFlow

Configuring sFlow or NetFlow on any interface disables all NP4 or NP4Lite offloading for all traffic on that interface.

Configuring NP4 traffic offloading

Offloading traffic to a network processor requires that the FortiGate unit configuration and the traffic itself is suited to hardware acceleration. There are requirements for path the sessions and the individual packets.

NP4 session fast path requirements

Sessions must be fast path ready. Fast path ready session characteristics are:

- Layer 2 type/length must be 0x0800 (IEEE 802.1q VLAN specification is supported)
- Layer 3 protocol must be IPv4
- Layer 4 protocol must be UDP, TCP or ICMP
- Layer 3 / Layer 4 header or content modification must not require a session helper (for example, SNAT, DNAT, and TTL reduction are supported, but application layer content modification is not supported)
- Firewall policies must not include proxy-based security features (proxy-based virus scanning, proxy-based web filtering, DNS filtering, DLP, Anti-Spam, VoIP, ICAP, Web Application Firewall, or Proxy options).
- If the FortiGate supports NTurbo, firewall policies can include flow-based security features (IPS, Application Control CASI, flow-based antivirus, or flow-based web filtering) .
- Origin must not be local host (the FortiGate unit)

If you disable anomaly checks by Intrusion Prevention (IPS), you can still enable NP4 hardware accelerated anomaly checks using the `fp-anomaly` field of the `config system interface` CLI command. See Offloading NP4 anomaly detection on page 110Offloading NP4 anomaly detection on page 110

If a session is not fast path ready, the FortiGate unit will not send the session key to the network processor(s). Without the session key, all session key lookup by a network processor for incoming packets of that session fails, causing all session packets to be sent to the FortiGate unit's main processing resources, and processed at normal speeds.

If a session is fast path ready, the FortiGate unit will send the session key to the network processor(s). Session key lookup then succeeds for subsequent packets from the known session.

Packet fast path requirements

Packets within the session must then also meet packet requirements.

- Incoming packets must not be fragmented.
- Outgoing packets must not require fragmentation to a size less than 385 bytes. Because of this requirement, the configured MTU (Maximum Transmission Unit) for network processors' network interfaces must also meet or exceed the network processors' supported minimum MTU of 385 bytes.

If packet requirements are not met, an individual packet will use FortiGate unit main processing resources, regardless of whether other packets in the session are offloaded to the specialized network processor(s).

In some cases, due to these requirements, a protocol's session(s) may receive a mixture of offloaded and non-offloaded processing.

For example, FTP uses two connections: a control connection and a data connection. The control connection requires a session helper, and cannot be offloaded, but the data connection does not require a session helper, and can be offloaded. Within the offloadable data session, fragmented packets will not be offloaded, but other packets will be offloaded.

Some traffic types differ from general offloading requirements, but still utilize some of the network processors' encryption and other capabilities. Exceptions include IPsec traffic and active-active high availability (HA) load balanced traffic.

Mixing fast path and non-fast path traffic

If packet requirements are not met, an individual packet will be processed by the FortiGate CPU regardless of whether other packets in the session are offloaded to the NP4.

Also, in some cases, a protocol's session(s) may receive a mixture of offloaded and non-offloaded processing. For example, VoIP control packets may not be offloaded but VoIP data packets (voice packets) may be offloaded.

Increasing NP4 offloading capacity using link aggregation groups (LAGs)

NP4 processors can offload sessions received by interfaces in link aggregation groups (LAGs) (IEEE 802.3ad). A LAG combines more than one physical interface into a group that functions like a single interface with a higher capacity than a single physical interface. For example, you could use a LAG if you want to offload sessions on a 3 Gbps link by adding three 1Gbps interfaces to the same LAG.

All offloaded traffic types are supported by LAGs, including IPsec VPN traffic. Just like with normal interfaces, traffic accepted by a LAG is offloaded by the NP4 processor connected to the interfaces in the LAG that receive the traffic to be offloaded. If all interfaces in a LAG are connected to the same NP4 processor, traffic received by that LAG is offloaded by that NP4 processor. The amount of traffic that can be offloaded is limited by the capacity of the NP4 processor.

If a FortiGate has two or more NP4 processors connected by an integrated switch fabric (ISF), you can use LAGs to increase offloading by sharing the traffic load across multiple NP4 processors. You do this by adding physical interfaces connected to different NP4 processors to the same LAG.

Adding a second NP4 processor to a LAG effectively doubles the offloading capacity of the LAG. Adding a third further increases offloading. The actual increase in offloading capacity may not actually be doubled by adding a second NP4 or tripled by adding a thrid. Traffic and load conditions and other factors may limit the actual offloading result.

The increase in offloading capacity offered by LAGs and multiple NP4s is supported by the ISF that allows multiple NP4 processors to share session information. On models that have more than one NP4 and no ISF, if you attempt to add interfaces connected to different NP4 processors to a LAG the system displays an error message.

There are also a few limitations to LAG NP4 offloading support for IPsec VPN:

- IPsec VPN anti-replay protection cannot be used if IPSec is configured on a LAG that has interfaces connected to multiple NP4 processors.
- Using a LAG connected to multiple NP4 processors for decrypting incoming IPsec VPN traffic may cause some of the incoming traffic to be decrypted by the CPU. So this configuration is not recommended since not all decryption is offloaded. (Using a LAG connected to multiple NP4 processors for encrypting outgoing IPsec VPN traffic is supported with no limitations.)
- Because the encrypted traffic for one IPsec VPN tunnel has the same 5-tuple, the traffic from one tunnel can only can be balanced to one interface in a LAG. This limits the maximum throughput for one IPsec VPN tunnel in an NP4 LAG group to 1Gbps.

NP4 traffic shaping offloading

Accelerated Traffic shaping is supported by NP4 processors with the following limitations.

- NP4 processors support policy-based traffic shaping. However, fast path traffic and traffic handled by the FortiGate CPU (slow path) are controlled separately, which means the policy setting on fast path does not consider the traffic on the slow path.
- The port based traffic policing as defined by the inbandwidth and outbandwidth CLI commands is not supported.
- DSCP configurations are supported.
- Per-IP traffic shaping is supported.
- QoS in general is not supported.

NP4Lite processors do not support traffic shaping for offloaded sessions.

You can also use the traffic shaping features of the FortiGate unit's main processing resources by disabling NP4 offloding. See Disabling NP offloading for firewall policies on page 23.

NP4 IPsec VPN offloading

NP4 processors improve IPsec tunnel performance by offloading IPsec encryption and decryption.

Requirements for hardware accelerated IPsec encryption or decryption are a modification of general offloading requirements. Differing characteristics are:

- Origin can be local host (the FortiGate unit)
- In Phase 1 configuration, Local Gateway IP must be specified as an IP address of a network interface for a port attached to a network processor
- SA must have been received by the network processor
- in Phase 2 configuration:
  - encryption algorithm must be DES, 3DES, AES-128, AES-192, AES-256, or null
  - authentication must be MD5, SHA1, or null
  - if encryption is null, authentication must not also be null

To apply hardware accelerated encryption and decryption, the FortiGate unit's main processing resources must first perform Phase 1 negotiations to establish the security association (SA). The SA includes cryptographic processing instructions required by the network processor, such as which encryption algorithms must be applied to the tunnel. After ISAKMP negotiations, the FortiGate unit's main processing resources send the SA to the network processor, enabling the network processor to apply the negotiated hardware accelerated encryption or decryption to tunnel traffic.

Possible accelerated cryptographic paths are:

- IPsec decryption offload
  - Ingress ESP packet > Offloaded decryption > Decrypted packet egress (fast path)
  - Ingress ESP packet > Offloaded decryption > Decrypted packet to FortiGate unit's main processing resources
- IPsec encryption offload
  - Ingress packet > Offloaded encryption > Encrypted (ESP) packet egress (fast path)

- Packet from FortiGate unit's main processing resources > Offloaded encryption > Encrypted (ESP) packet egress

Configuring Inter-VDOM link acceleration with NP4 processors

FortiGate units with NP4 processors include inter-VDOM links that can be used to accelerate inter-VDOM link traffic.

Traffic is blocked if you enable IPS for traffic passing over inter-VDOM links if that traffic is being offloaded by an NP4 processor.If you disable NP4 offloading traffic will be allowed to flow. You can disable offloading in individual firewall policies by disabling `auto-asic-offload` for those policies. You can also use the following command to disable all IPS offloading

```
config ips global
   set np-accel-mode none
   set cp-accel-mode none
end
```

- For a FortiGate unit with two NP4 processors there are also two inter-VDOM links, each with two interfaces:
  - **npu0-vlink:**
    npu0-vlink0
    npu0-vlink1
  - **npu1-vlink:**
    npu1-vlink0
    npu1-vlink1

These interfaces are visible from the GUI and CLI. For a FortiGate unit with NP4 interfaces, enter the following CLI command (output shown for a FortiGate-5001B):

```
get hardware npu np4 list
ID    Model        Slot       Interface
0     On-board                port1 port2 port3 port4
                              fabric1 base1 npu0-vlink0 npu0-vlink1
1     On-board                port5 port6 port7 port8
                              fabric2 base2 npu1-vlink0 npu1-vlink1
```

By default the interfaces in each inter-VDOM link are assigned to the root VDOM. To use these interfaces to accelerate inter-VDOM link traffic, assign each interface in a pair to the VDOMs that you want to offload traffic between. For example, if you have added a VDOM named New-VDOM to a FortiGate unit with NP4 processors, you can go to **System > Network > Interfaces** and edit the **npu0-vlink1** interface and set the **Virtual Domain** to **New-VDOM**.

This results in an inter-VDOM link between root and New-VDOM. You can also do this from the CLI:

```
config system interface
   edit npu0-vlink1
      set vdom New-VDOM
end
```

Using VLANs to add more accelerated Inter-VDOM links

You can add VLAN interfaces to the accelerated inter-VDOM links to create inter-VDOM links between more VDOMs. For the links to work, the VLAN interfaces must be added to the same inter-VDOM link, must be on the same subnet, and must have the same VLAN ID.

For example, to accelerate inter-VDOM link traffic between VDOMs named Marketing and Engineering using VLANs with VLAN ID 100 go to **System > Network > Interfaces** and select **Create New** to create the VLAN interface associated with the Marketing VDOM:

Name	Marketing-link
Type	VLAN
Interface	npu0-vlink0
VLAN ID	100
Virtual Domain	Marketing
IP/Network Mask	172.20.120.12/24

Create the inter-VDOM link associated with Engineering VDOM:

Name	Engineering-link
Type	VLAN
Interface	npu0-vlink1
VLAN ID	100
Virtual Domain	Engineering
IP/Network Mask	172.20.120.22/24

Or do the same from the CLI:

```
config system interface
   edit Marketing-link
      set vdom Marketing
      set ip 172.20.120.12/24
      set interface npu0-vlink0
      set vlanid 100
   next
   edit Engineering-link
      set vdom Engineering
      set ip 172.20.120.22/24
      set interface npu0-vlink1
      set vlanid 100
```

Confirm that the traffic is accelerated

Use the following CLI commands to obtain the interface index and then correlate them with the session entries. In the following example traffic was flowing between new accelerated inter-VDOM links and physical ports port1 and port 2 also attached to the NP4 processor.

```
diagnose ip address list
IP=172.31.17.76->172.31.17.76/255.255.252.0 index=5 devname=port1
IP=10.74.1.76->10.74.1.76/255.255.252.0 index=6 devname=port2
IP=172.20.120.12->172.20.120.12/255.255.255.0 index=55 devname=IVL-VLAN1_ROOT
IP=172.20.120.22->172.20.120.22/255.255.255.0 index=56 devname=IVL-VLAN1_VDOM1

diagnose sys session list
session info: proto=1 proto_state=00 duration=282 expire=24 timeout=0 session info:
    proto=1 proto_state=00 duration=124 expire=59 timeout=0 flags=00000000
    sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/
state=may_dirty npu
statistic(bytes/packets/allow_err): org=180/3/1 reply=120/2/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=55->5/5->55
    gwy=172.31.19.254/172.20.120.22
hook=post dir=org act=snat 10.74.2.87:768->10.2.2.2:8(172.31.17.76:62464)
hook=pre dir=reply act=dnat 10.2.2.2:62464->172.31.17.76:0(10.74.2.87:768)
misc=0 policy_id=4 id_policy_id=0 auth_info=0 chk_client_info=0 vd=0
serial=0000004e tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=10.74.2.87, bps=880
npu_state=00000000
npu info: flag=0x81/0x81, offload=4/4, ips_offload=0/0, epid=160/218, ipid=218/160,
    vlan=32769/0

session info: proto=1 proto_state=00 duration=124 expire=20 timeout=0 flags=00000000
    sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/
state=may_dirty npu
statistic(bytes/packets/allow_err): org=180/3/1 reply=120/2/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=6->56/56->6
    gwy=172.20.120.12/10.74.2.87
```

```
hook=pre dir=org act=noop 10.74.2.87:768->10.2.2.2:8(0.0.0.0:0)
hook=post dir=reply act=noop 10.2.2.2:768->10.74.2.87:0(0.0.0.0:0)
misc=0 policy_id=3 id_policy_id=0 auth_info=0 chk_client_info=0 vd=1
serial=0000004d tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=10.74.2.87, bps=880
npu_state=00000000
npu info: flag=0x81/0x81, offload=4/4, ips_offload=0/0, epid=219/161, ipid=161/219,
    vlan=0/32769
total session 2
```

Offloading NP4 anomaly detection

Network interfaces associated with a port attached to an NP4 processor can be configured to offload anomaly checking to the NP4 processor. This anomaly checking happens before other offloading and separately from DoS policy anomaly checking. Using the following command, each FortiGate interface can have a different anomaly checking configuration even if they are connected to the same NP4 processor.

The options available for this command apply anomaly checking for NP4 sessions in the same way as the command descrbed in Configuring individual NP6 processors on page 39 applies anomaly checking for for NP6 sessions.

```
config system interface
   edit <port-name>
      set fp-anomaly <anomalies>
   end
```

where `<anomalies>` can be one, more than one or all of the following:

Anomaly	Description
drop_icmp_frag	Drop ICMP fragments to pass.
drop_icmpland	Drop ICMP Land.
drop_ipland	Drop IP Land.
drop_iplsrr	Drop IP with Loose Source Record Route option.
drop_iprr	Drop IP with Record Route option.
drop_ipsecurity	Drop IP with Security option.
drop_ipssrr	Drop IP with Strict Source Record Route option.
drop_ipstream	Drop IP with Stream option.
drop_iptimestamp	Drop IP with Timestamp option.

Anomaly	Description
drop_ipunknown_option	Drop IP with malformed option.
drop_ipunknown_prot	Drop IP with Unknown protocol.
drop_tcp_fin_noack	Drop TCP FIN with no ACT flag set to pass.
drop_tcp_no_flag	Drop TCP with no flag set to pass.
drop_tcpland	Drop TCP Land.
drop_udpland	Drop UDP Land.
drop_winnuke	Drop TCP WinNuke.
pass_icmp_frag	Allow ICMP fragments to pass.
pass_icmpland	Allow ICMP Land to pass.
pass_ipland	Allow IP land to pass.
pass_iplsrr	Allow IP with Loose Source Record Route option to pass.
pass_iprr	Allow IP with Record Route option to pass.
pass_ipsecurity	Allow IP with Security option to pass.
pass_ipssrr	Allow IP with Strict Source Record Route option to pass.
pass_ipstream	Allow IP with Stream option to pass.
pass_iptimestamp	Allow IP with Timestamp option to pass.
pass_ipunknown_option	Allow IP with malformed option to pass.
pass_ipunknown_prot	Allow IP with Unknown protocol to pass.
pass_tcp_fin_noack	Allow TCP FIN with no ACT flag set to pass.
pass_tcp_no_flag	Allow TCP with no flag set to pass.
pass_tcpland	Allow TCP Land to pass.

Anomaly	Description
pass_udpland	Allow UDP Land to pass.
pass_winnuke	Allow TCP WinNuke to pass.

Example

You might configure an NP4 to drop packets with TCP WinNuke or unknown IP protocol anomalies, but to pass packets with an IP time stamp, using hardware acceleration provided by the network processor.

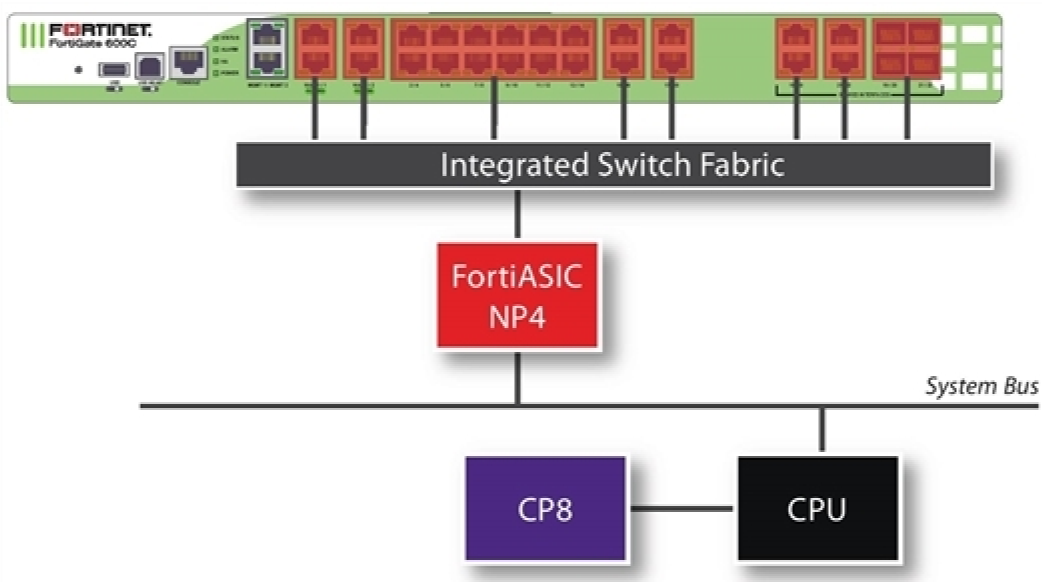
```
config system interface
   edit port1
      set fp-anomaly drop_winnuke drop_ipunknown_prot pass_iptimestamp
   end
```

FortiGate NP4 architectures

This chapter shows the NP4 architecture for the all FortiGate models that include NP4 processors.

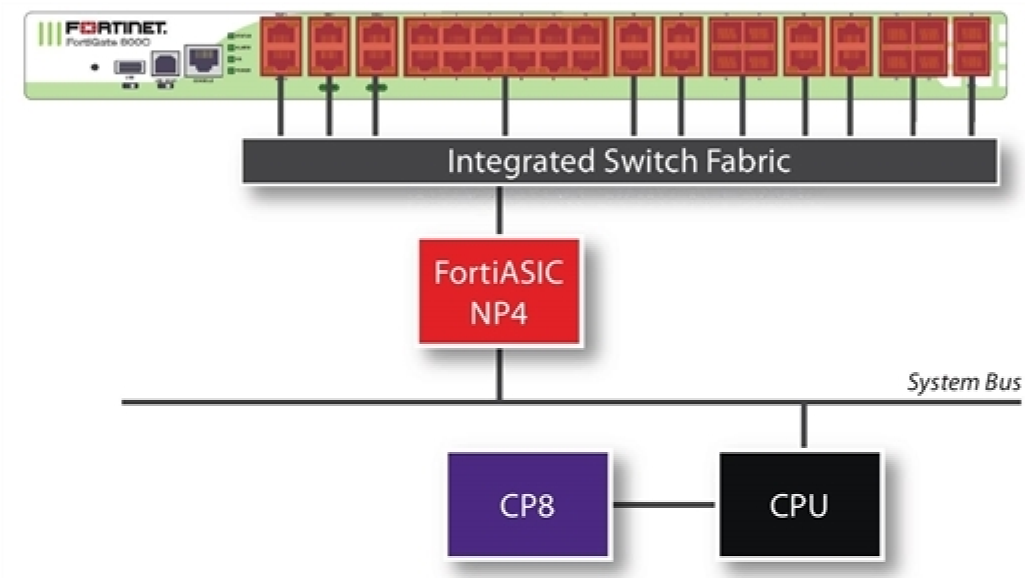
FortiGate-600C

The FortiGate-600C features one NP4 processor. All the ports are connected to this NP4 over the Integrated Switch Fabric. Port1 and port2 are dual failopen redundant RJ-45 ports. Port3-port22 are RJ-45 ethernet ports, and there are four 1Gb SFP interface ports duplicating the port19-port22 connections.



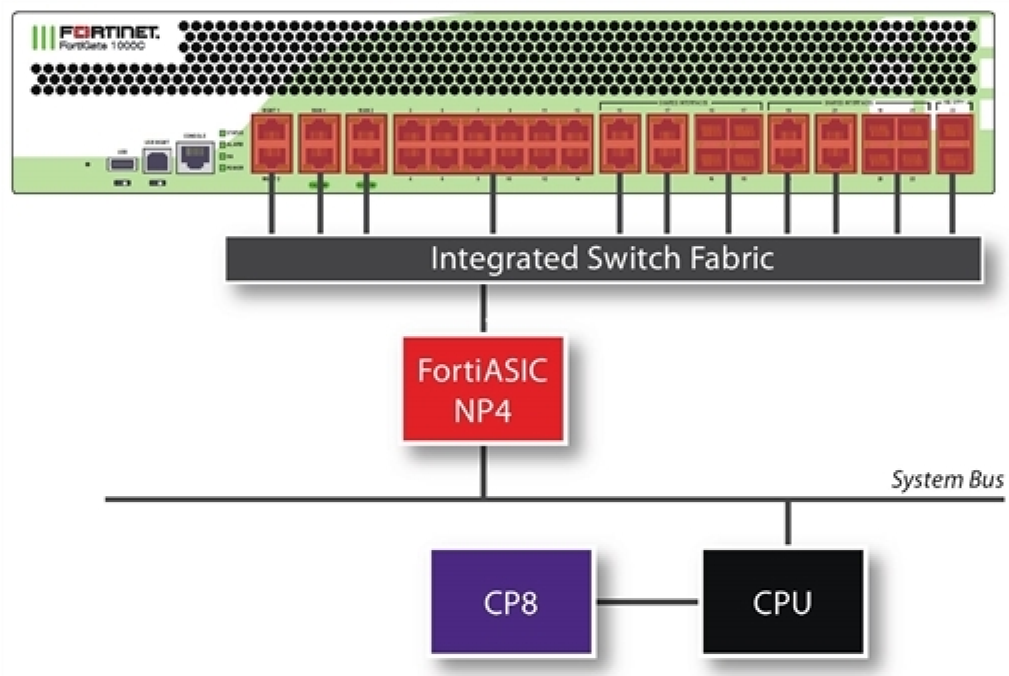
FortiGate-800C

The FortiGate-800C features one NP4 processor. All the ports are connected to this NP4. Port1 and port2 are dual failopen redundant RJ-45 ports. Port3-port22 are RJ-45 Ethernet ports, and there are eight 1Gb SFP interface ports duplicating the port15-18 and port19-port22 connections. There are also two 10Gb SFP+ ports, port23 and port24.



FortiGate-1000C

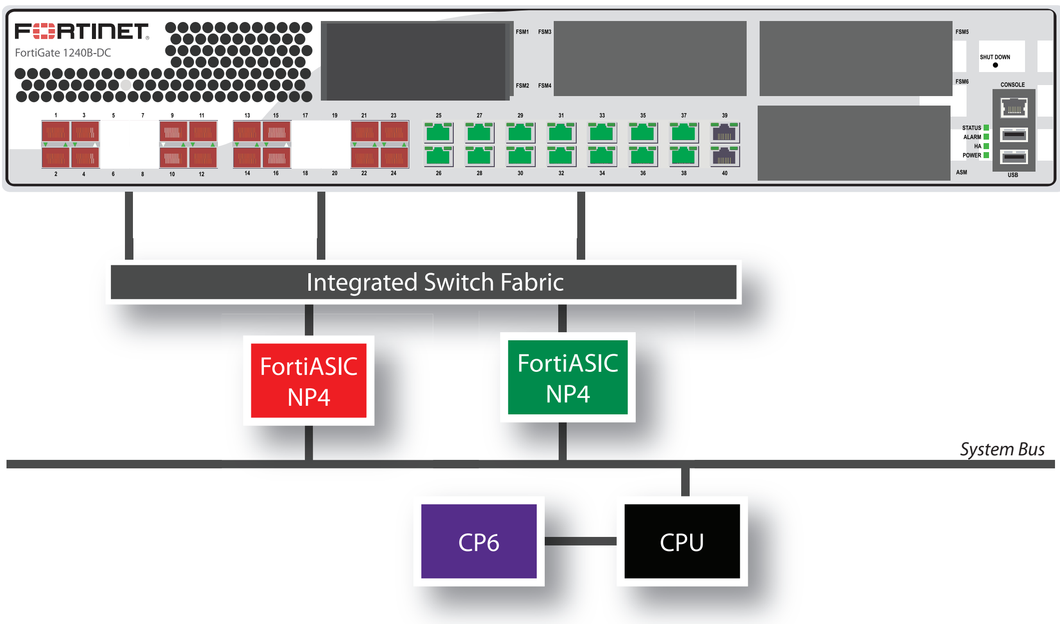
The FortiGate-1000C features one NP4 processor. All the ports are connected to this NP4. Port1 and port2 are dual failopen redundant RJ-45 ports. Port3-port22 are RJ-45 ethernet ports, and there are eight 1Gb SFP interface ports duplicating the port15-18 and port19-port22 connections. There are also two 10Gb SFP+ ports, port23 and port24.



FortiGate-1240B

The FortiGate-1240B features two NP4 processors:

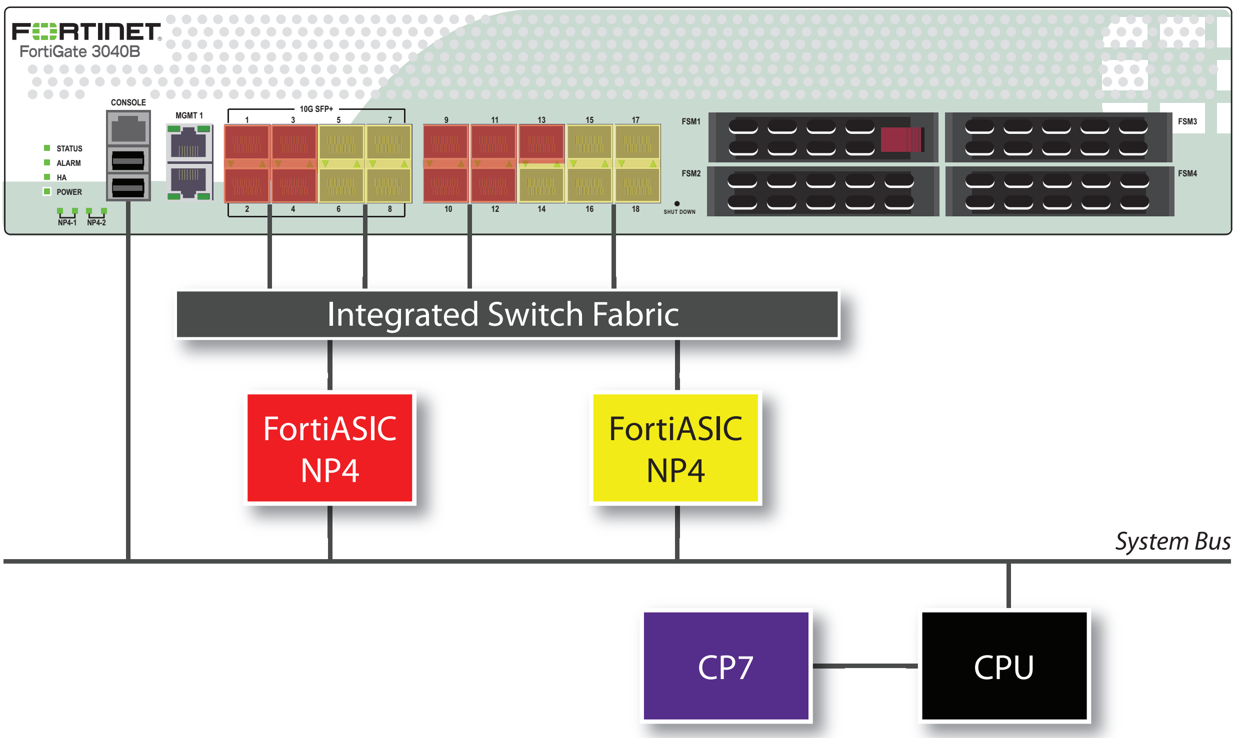
- Port1 to port24 are 1Gb SFP interfaces connected to one NP4 processor.
- Port25 to port38 are RJ-45 ethernet ports, connected to the other NP4 processor.
- Port39 and port40 are not connected to an NP4 processor.



FortiGate-3040B

The FortiGate-3040B features two NP4 processors:

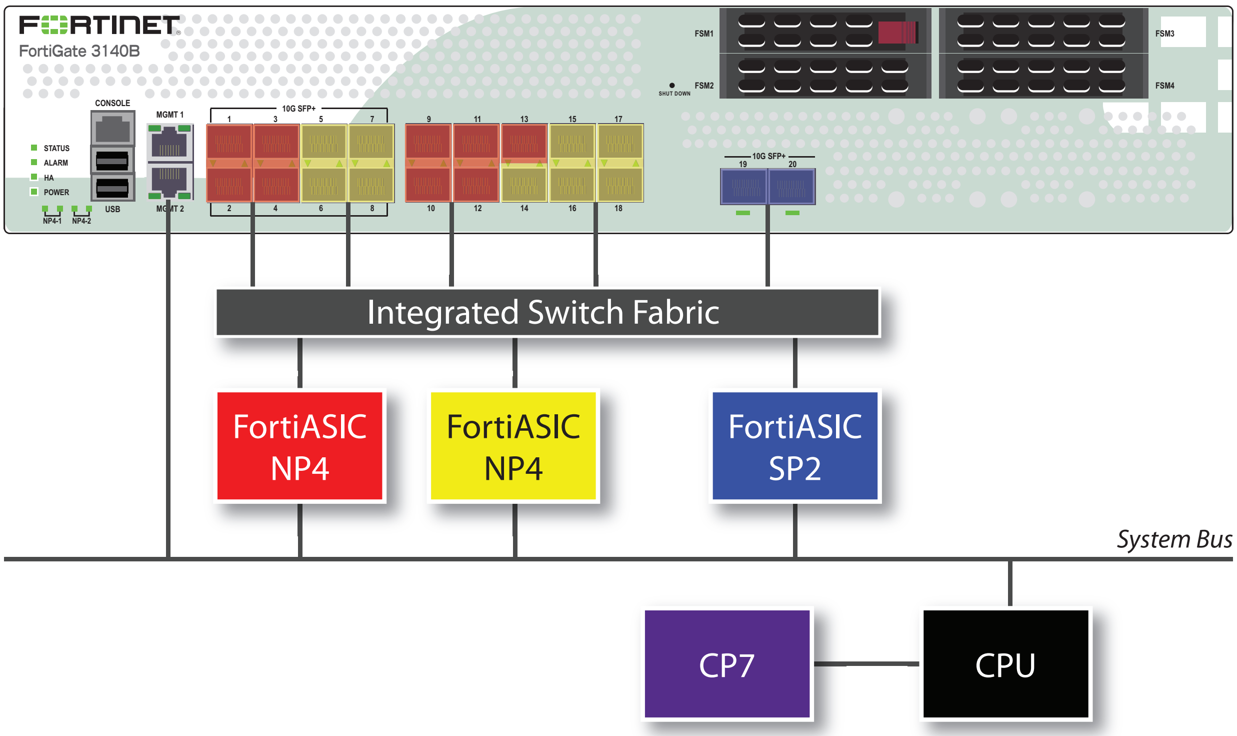
- The 10Gb interfaces, port1, port2, port3, port4, and the 1Gb interfaces, port9, port10, port11, port12, port13, share connections to one NP4 processor.
- The 10Gb interfaces, port5, port6, port7, port8, and the 1Gb interfaces, port14, port15, port16, port17, port18, share connections to the other NP4 processor.



FortiGate-3140B

The FortiGate-3140B features two NP4 processors and one SP2 processor:

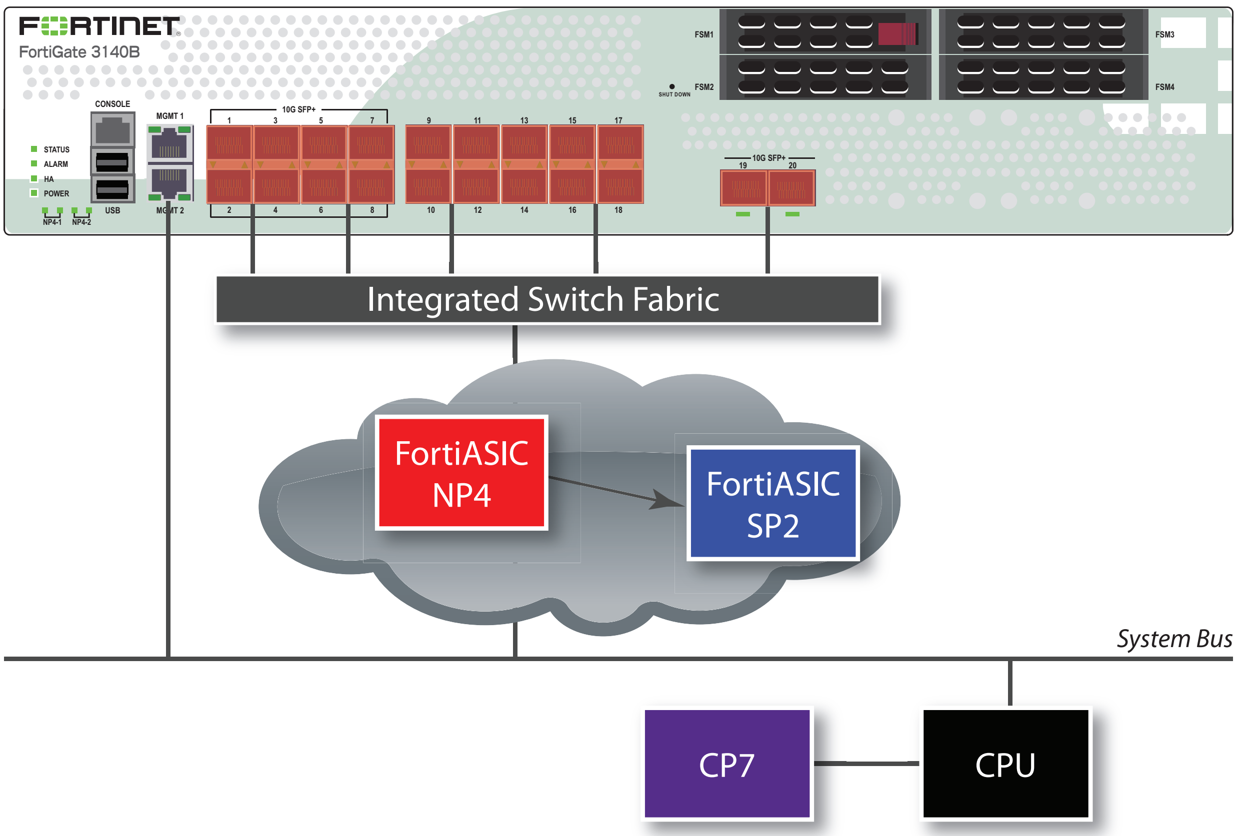
- The 10Gb interfaces, port1, port2, port3, port4, and the 1Gb interfaces, port9, port10, port11, port12, port13, share connections to one NP4 processor.
- The 10Gb interfaces, port5, port6, port7, port8, and the 1Gb interfaces, port14, port15, port16, port17, port18, share connections to the other NP4 processor.
- The 10Gb interfaces, port19 and port20, share connections to the SP2 processor.



FortiGate-3140B — load balance mode

The FortiGate-3140B load balance mode allows you increased flexibility in how you use the interfaces on the FortiGate unit. When enabled, traffic between any two interfaces (excluding management and console) is accelerated. Traffic is not limited to entering and leaving the FortiGate unit in specific interface groupings to benefit from NP4 and SP2 acceleration. You can use any pair of interfaces.

Security acceleration in this mode is limited, however. Only IPS scanning is accelerated in load balance mode.



To enable this feature, issue this CLI command.

```
config system global
   set sp-load-balance enable
end
```

The FortiGate unit will then restart.

To return to the default mode, issue this CLI command.

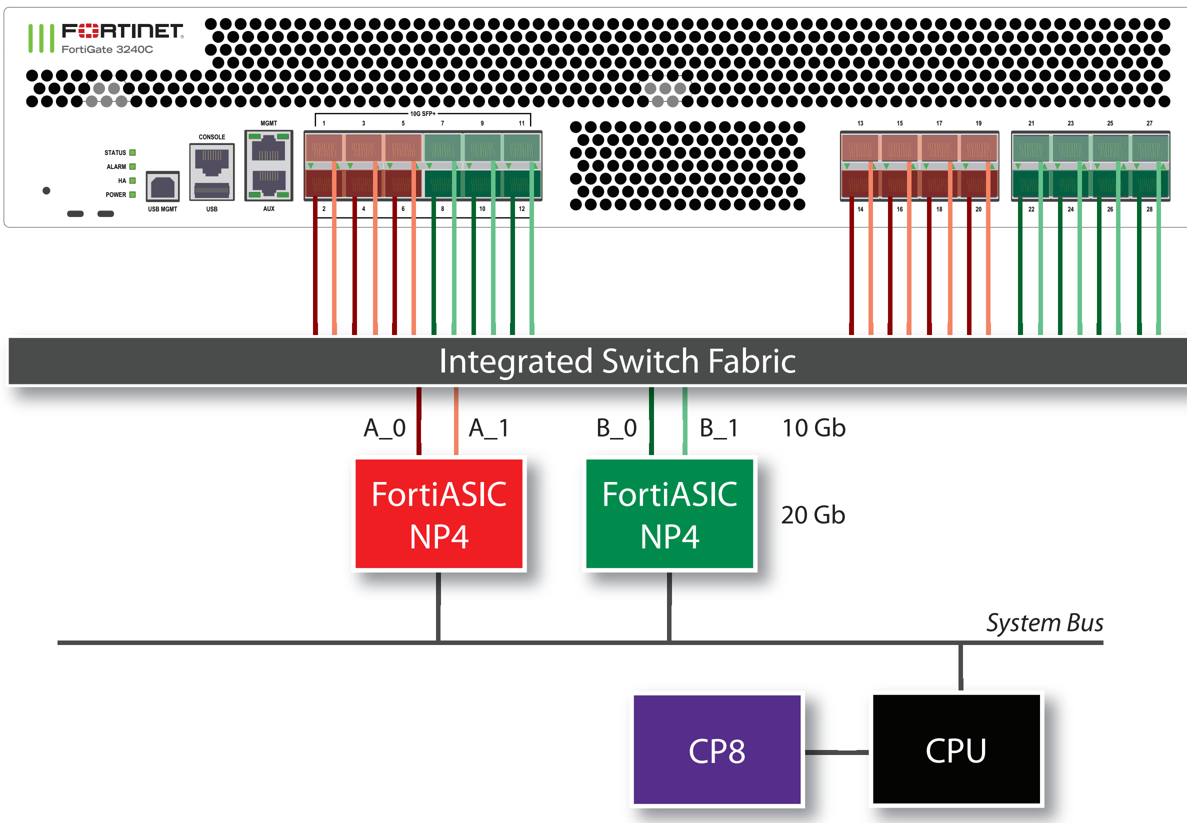
```
config system global
   set sp-load-balance disable
end
```

FortiGate-3240C

The FortiGate-3240C features two NP4 processors:

- The 10Gb interfaces, port1 through port6, and the 1Gb interfaces, port13 through port20, share connections to one NP4 processor.
- The 10Gb interfaces, port7 through port12, and the 1Gb interfaces, port21 through port28, share connections to the other NP4 processor.

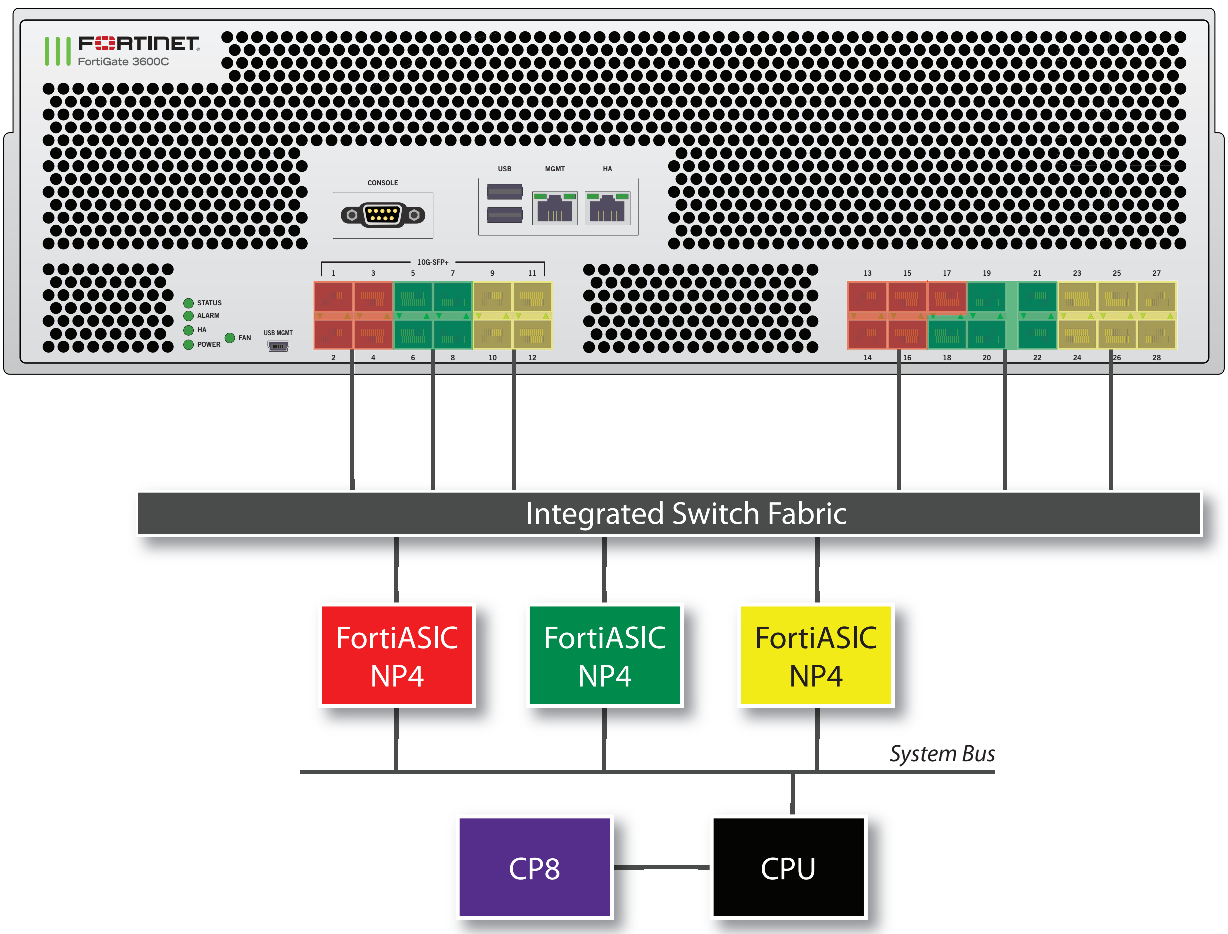
In addition to the ports being divided between the two NP4 processors, they are further divided between the two connections to each processor. Each NP4 can process 20 Gb of network traffic per second and each of two connections to each NP4 can move 10Gb of data to the processor per second, so the ideal configuration would have no more than 10 Gb of network traffic to each connection of each NP4 at any time.



FortiGate-3600C

The FortiGate-3600C features three NP4 processors:

- The 10Gb interfaces, port1-port4, and the 1Gb interfaces, port13-port17, share connections to one NP4 processor.
- The 10Gb interfaces, port5-port8, and the 1Gb interfaces, port18-port22 share connections to the second NP4 processor.
- The 10Gb interfaces, port9-port12, and the 1Gb interfaces, port23-port28 share connections to the third NP4 processor.



FortiGate-3600C XAUI links

The FortiGate-3600C uses XAUI links for communication between physical Ethernet ports and the integrated switch fabric.

Each XAUI link has a maximum bandwidth of 10-Gigabits. The reason you may need to know about the XAUI link in NP4 configurations is because of this 10-Gigabit limit. Because of this limitation, the total amount of data processed by all Ethernet interfaces connected to an XAUI link cannot exceed 10 gigabits. In some cases this may limit the amount of bandwidth that the FortiGate can process.

Each NP4 processor connects to the integrated switch fabric through two XAUI links: XAUI0 and XAUI1. All of the odd numbered Ethernet interfaces use XAU0 and all of the even numbered interfaces use XAUI1:

NPU1

XAUI0 = port1,port3,port13, port15, port17

XAUI1 = port2, port4, port14, port16

NPU2

XAUI0 = port5, port7, port18, port20, port22

XAUI1 = port6, port8, port19, port21

NPU3

XAUI0 = port9, port11, port23, port25, port27

XAUI1 = port10, port12, port24, port26, port28

Usually you do not have to be concerned about XAUI link mapping. However, if a FortiGate-3600C NP4 interface is processing a very high amount of traffic you should distribute that traffic among both of the XAUI links connected to it. So if you have a very high volume of traffic flowing between two networks you should connect both networks to the same NP4 processor but to different XAUI links. For example, you could connect one network to Ethernet port5 and the other network to Ethernet port6. In this configuration, the second NP4 processor would handle traffic acceleration and both XAUI links would be processing traffic.

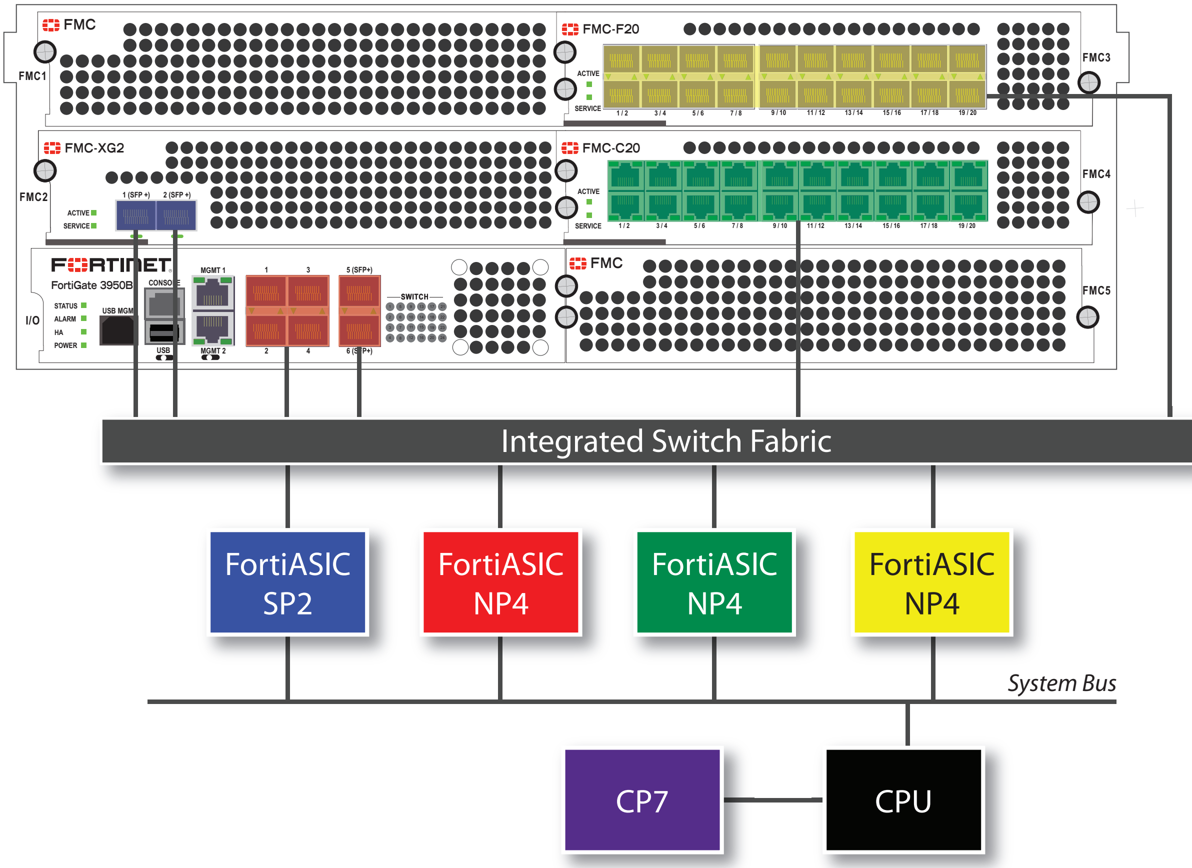
FortiGate-3950B and FortiGate-3951B

The FortiGate-3950B features one NP4 processor. The 1Gb SPF interfaces, port1, port2, port3, port4, and the 10Gb SPF+ interfaces, port5, port6, share connections to one NP4 processor. The FortiGate-3951B is similar to the FortiGate-3950B, except it trades one FMC slot for four FSM slots. The network interfaces available on each model are identical.

You can add additional FMC interface modules. The diagram below shows a FortiGate-3950B with three modules installed: an FMC-XG2, an FMC-F20, and an FMC-C20.

- The FMC-XG2 has one SP2 processor. The 10Gb SPF+ interfaces, port1 and port2, share connections to the processor.

- The FMC-F20 has one NP4 processor and the twenty 1Gb SPF interfaces, port1 through port20, share connections to the NP4 processor.
- The FMC-C20 has one NP4 processor and the twenty 10/100/1000 interfaces, port1 through port20, share connections to the NP4 processor.



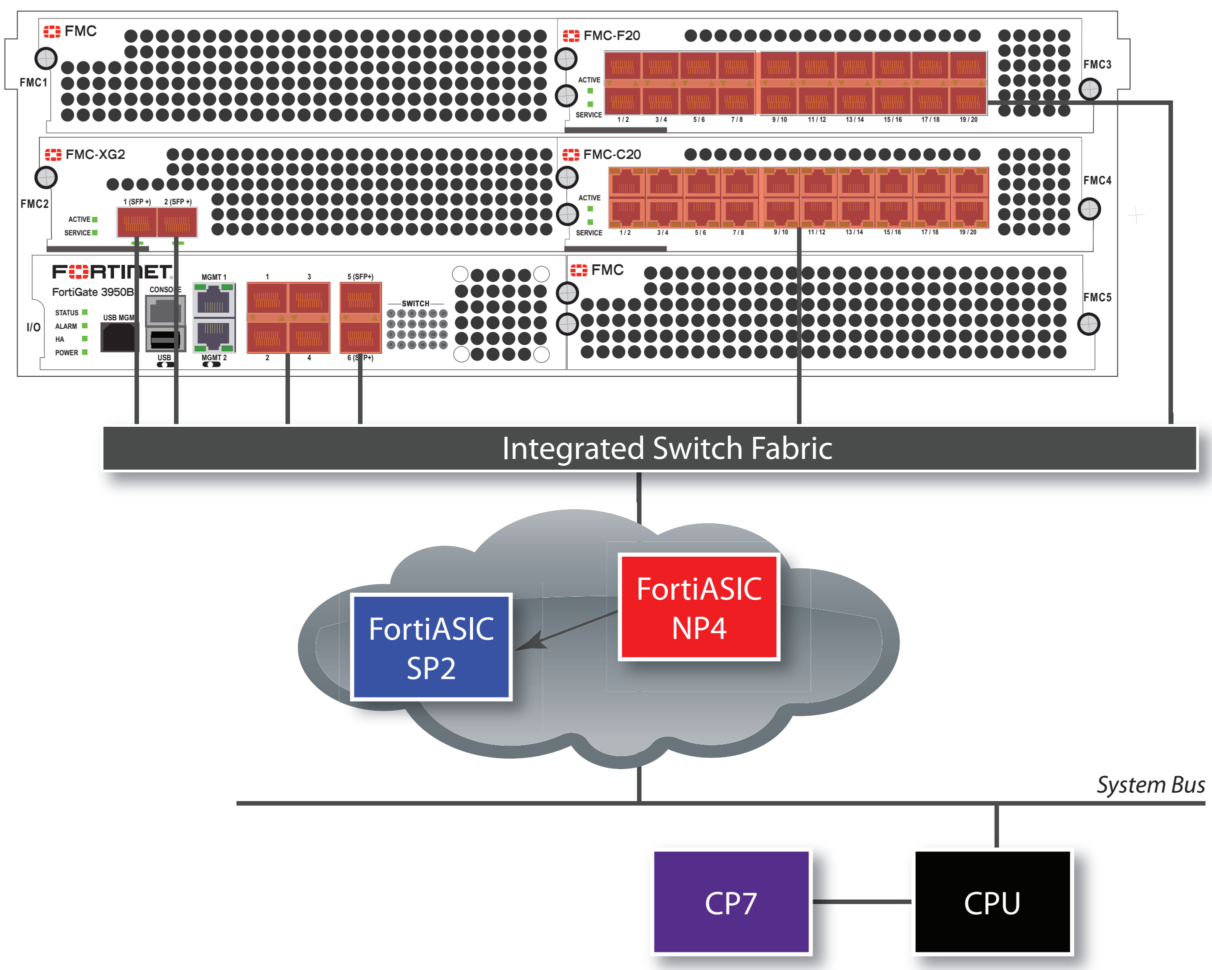
FortiGate-3950B and FortiGate-3951B — load balance mode

Adding one or more FMC-XG2 modules to your FortiGate-3950B allows you to enable load balance mode. This feature allows you increased flexibility in how you use the interfaces on the FortiGate unit. The FortiGate-3951B is similar to the FortiGate-3950B, except it trades one FMC slot for four FSM slots. The network interfaces available on each model are identical.

When enabled, traffic between any two interfaces (excluding management and console) is accelerated whether they are the six interfaces on the FortiGate-3950B itself, or on any installed FMC modules. Traffic is not limited to entering and leaving the FortiGate unit in specific interface groupings to benefit from NP4 and SP2 acceleration. You can use any pair of interfaces.

Security acceleration in this mode is limited, however. Only IPS scanning is accelerated in load balance mode.

The FortiGate-3950B in load balance mode



To enable this feature, issue this CLI command.

```
config system global
```

```
    set sp-load-balance enable
end
```

The FortiGate unit will then restart.

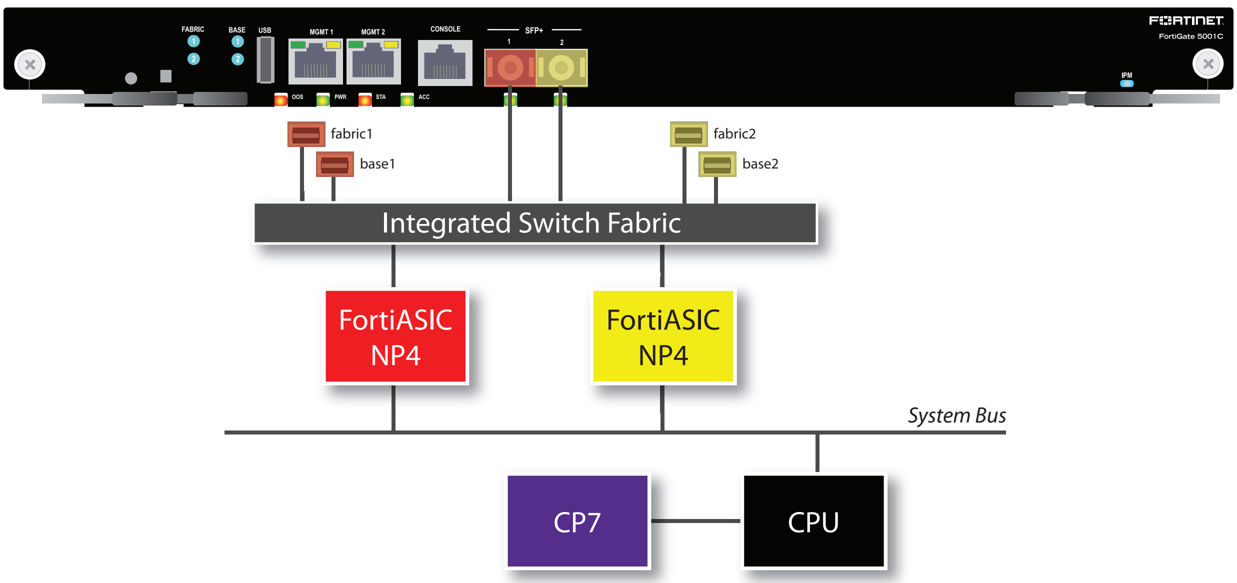
To return to the default mode, issue this CLI command.

```
config system global
    set sp-load-balance disable
end
```

FortiGate-5001C

The FortiGate-5001C board includes two NP4 processors connected to an integrated switch fabric:

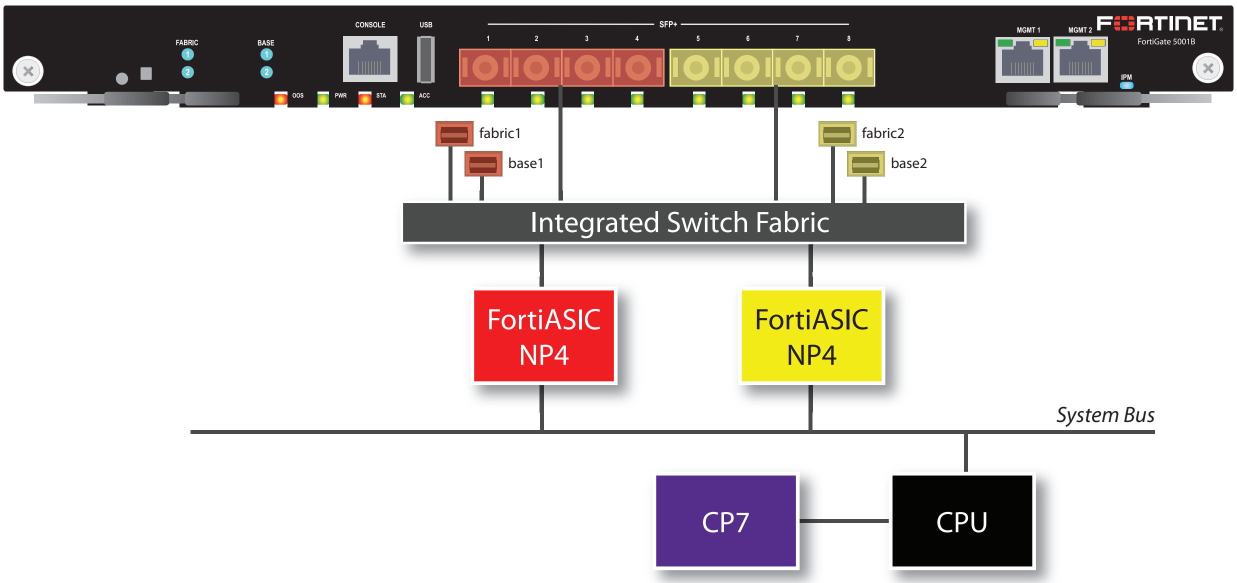
- The port1, fabric1, and base1 interfaces are connected to one NP4 processor.
- The port2, fabric2, and base2 interfaces are connected to the other NP4 processor.



FortiGate-5001B

The FortiGate-5001B board includes two NP4 connected to an integrated switch fabric.

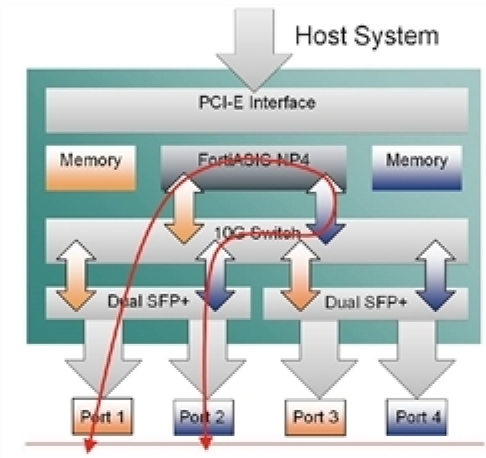
- The port1, port2, port3, port4, fabric1 and base1 interfaces are connected to one NP4 processor.
- The port5, port6, port7, port8, fabric2 and base2 interfaces are connected to the other NP4 processor.



Setting switch-mode mapping on the ADM-XD4

The ADM-XD4 SP has four 10Gb/s ports, but the NP4 processor it contains has only two 10Gb/s ports. The external ports you use are important to optimize the SP for your application.

ADM-XD4 mapping mode



Ports 1 and 3 share one NP4 processor and ports 2 and 4 share the other. Performance ports sharing the same NP4 processor is far better than when forcing network data to move between NP4 processors by using one port from each, for example ports 1 and 2 or ports 3 and 4.

Hardware acceleration get and diagnose commands

This section describes some `get` and `diagnose` commands you can use to display useful information about the NP6 processors sessions processed by NP6 processors.

get hardware npu np6

You can use the `get hardware npu np6` command to display information about the NP6 processors in your FortiGate and the sessions they are processing. This command contains a subset of the options available from the `diagnose npu np6` command. The command syntax is:

```
get hardware npu np6 {dce <np6-id> | ipsec-stats | port-list | session-stats <np6-id> |
    sse-stats <np6-id> | synproxy-stats}
```

`<np6-id>` identifies the NP6 processor. `0` is `np6_0`, `1` is `np6_1` and so on.

`dce` show NP6 non-zero sub-engine drop counters for the selected NP6.

`ipsec-stats` show overall NP6 IPsec offloading statistics.

`port-list` show the mapping between the FortiGate's physical ports and its NP6 processors.

`session-stats` show NP6 session offloading statistics counters for the selected NP6.

`sse-stats` show hardware session statistics counters.

`synproxy-stats` show overall NP6 synproxy statistics for TCP connections identified as being syn proxy DoS attacks.

diagnose npu np6

The diagnose npu np6 command displays extensive information about NP6 processors and the sessions that they are processing. Some of the information displayed can be useful for understanding the NP6 configuration, seeing how sessions are being processed and diagnosing problems. Some of the commands may only be useful for Fortinet software developers. The command syntax is:

```
diagnose npu np6 {options}
```

The following options are available:

`fastpath {disable | enable} <np6-od>` enable or disable fastpath processing for a selected NP6.

`dce` shows NP6 non-zero sub-engine drop counters for the selected NP6.

`dce-all` show all subengine drop counters.

`anomaly-drop` show non-zero L3/L4 anomaly check drop counters.

`anomaly-drop-all` show all L3/L4 anomaly check drop counters.

`hrx-drop` show non-zero host interface drop counters.

`hrx-drop-all` show all host interface drop counters.

`session-stats` show session offloading statistics counters.

`session-stats-clear` clear sesssion offloading statistics counters.

`sse-stats` show hardware session statistics counters.

`sse-stats-clear` show hardware session statistics counters.

`pdq` show packet buffer queue counters.

`xgmac-stats` show XGMAC MIBs counters.

`xgmac-stats-clear` clear XGMAC MIBS counters.

`port-list` show port list.

`ipsec-stats` show IPsec offloading statistics.

`ipsec-stats-clear` clear IPsec offloading statistics.

`eeprom-read` read NP6 EEPROM.

`npu-feature` show NPU feature and status.

`register` show NP6 registers.

`fortilink` configure fortilink.

`synproxy-stats` show synproxy statistics.

Using diagnose npu np6 npu-feature to verify enabled NP6 features

You can use the `diagnose npu np6 npu-feature` command to see what NP6 features are enabled and which are not. The following command output shows the normal default NP6 configuration for most FortiGates. In this output all features are enabled except low latency features and GRE offloading. Low latency is only available on the FortiGate-3700D and DX models and GRE offloading will become available in a future FortiOS release. The following output is from a FortiGate-1500D

```
diagnose npu np6 npu-feature
                    np_0      np_1
------------------- --------- ---------
Fastpath            Enabled   Enabled
Low-latency-mode    Disabled  Disabled
Low-latency-cap     No        No
IPv4 firewall       Yes       Yes
IPv6 firewall       Yes       Yes
IPv4 IPSec          Yes       Yes
IPv6 IPSec          Yes       Yes
IPv4 tunnel         Yes       Yes
IPv6 tunnel         Yes       Yes
GRE tunnel          No        No
IPv4 Multicast      Yes       Yes
IPv6 Multicast      Yes       Yes
CAPWAP              Yes       Yes
```

If you use the following command to disable fastpath for np_0:

```
config system np6
```

```
    edit np6_0
      set fastpath disable
    end
```

The `npu-feature` command output show this configuration change:

```
diagnose npu np6 npu-feature
                    np_0      np_1
------------------- --------- ---------
Fastpath            Disabled  Enabled
Low-latency-mode    Disabled  Disabled
Low-latency-cap     No        No
IPv4 firewall       Yes       Yes
IPv6 firewall       Yes       Yes
IPv4 IPSec          Yes       Yes
IPv6 IPSec          Yes       Yes
IPv4 tunnel         Yes       Yes
IPv6 tunnel         Yes       Yes
GRE tunnel          No        No
IPv4 Multicast      Yes       Yes
IPv6 Multicast      Yes       Yes
CAPWAP              Yes       Yes
```

Using the diagnose sys session/session6 list command

The `diagnose sys session list` and `diagnose sys session6 list` commands list all of the current IPv4 or IPv6 sessions being processed by the FortiGate. For each session the command output includes an `npu info` line that displays NPx offloading information for the session. If a session is not offloaded the command output includes a `no_ofld_reason` line that indicates why the session was not offloaded.

Displaying NP6 offloading information for a session

The `npu info` line of the `diagnose sys session list` command includes information about the offloaded session that indicates the type of processor and whether its IPsec or regular traffic:

- `offload=1/1` for NP1(FA1) sessions.
- `offload=2/2` for NP1(FA2) sessions.
- `offload=3/3` for NP2 sessions.
- `offload=4/4` for NP4 sessions.
- `offload=5/5` for XLR sessions.
- `offload=6/6` for Nplite/NP4lite sessions.
- `offload=7/7` for XLP sessions.
- `offload=8/8` for NP6 sessions.
- `flag 0x81` means regular traffic.
- `flag 0x82` means IPsec traffic.

Example offloaded IPv4 NP6 session

The following session output by the `diagnose sys session list` command shows an offloaded session. The information in the `npu info` line shows this is a regular session (`flag=0x81/0x81`) that is offloaded by an NP6 processor (`offload=8/8`).

```
diagnose sys session list
session info: proto=6 proto_state=01 duration=4599 expire=2753 timeout=3600 flags-
s=00000000 sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/ vlan_cos=0/255
state=log may_dirty npu none log-start
statistic(bytes/packets/allow_err): org=1549/20/1 reply=1090/15/1 tuples=2
speed(Bps/kbps): 0/0
orgin->sink: org pre->post, reply pre->post dev=15->17/17->15
gwy=172.20.121.2/5.5.5.33
hook=post dir=org act=snat 5.5.5.33:60656->91.190.218.66:12350
(172.20.121.135:60656)
hook=pre dir=reply act=dnat 91.190.218.66:12350->172.20.121.135:60656
(5.5.5.33:60656)
pos/(before,after) 0/(0,0), 0/(0,0)
src_mac=98:90:96:af:89:b9
misc=0 policy_id=1 auth_info=0 chk_client_info=0 vd=0
serial=00058b9c tos=ff/ff app_list=0 app=0 url_cat=0
dd_type=0 dd_mode=0
npu_state=0x000c00
npu info: flag=0x81/0x81, offload=8/8, ips_offload=0/0, epid=140/138, ipid-
d=138/140, vlan=0x0000/0x0000
vlifid=138/140, vtag_in=0x0000/0x0000 in_npu=1/1, out_npu=1/1, fwd_en=0/0, qid=0/2
```

Example IPv4 session that is not offloaded

The following session, output by the diagnose sys session list command includes the `no_ofld_reason` line that indicates that the session was not offloaded because it is a local-in session.

```
session info: proto=6 proto_state=01 duration=19 expire=3597 timeout=3600
flags=00000000 sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/ vlan_cos=8/8
state=local may_dirty
statistic(bytes/packets/allow_err): org=6338/15/1 reply=7129/12/1 tuples=2
speed(Bps/kbps): 680/5
orgin->sink: org pre->in, reply out->post dev=15->50/50->15 gwy=5.5.5.5/0.0.0.0
hook=pre dir=org act=noop 5.5.5.33:60567->5.5.5.5:443(0.0.0.0:0)
hook=post dir=reply act=noop 5.5.5.5:443->5.5.5.33:60567(0.0.0.0:0)
pos/(before,after) 0/(0,0), 0/(0,0)
src_mac=98:90:96:af:89:b9
misc=0 policy_id=0 auth_info=0 chk_client_info=0 vd=0
```

```
serial=000645d8 tos=ff/ff app_list=0 app=0 url_cat=0
dd_type=0 dd_mode=0
npu_state=00000000
no_ofld_reason:  local
```

Example IPv4 IPsec NP6 session

```
diagnose sys session list
session info: proto=6 proto_state=01 duration=34 expire=3565 timeout=3600 flags-
s=00000000 sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/p1-vdom2
state=re may_dirty npu
statistic(bytes/packets/allow_err): org=112/2/1 reply=112/2/1 tuples=2
orgin->sink: org pre->post, reply pre->post dev=57->7/7->57 gwy-
y=10.1.100.11/11.11.11.1
hook=pre dir=org act=noop 172.16.200.55:35254->10.1.100.11:80(0.0.0.0:0)
hook=post dir=reply act=noop 10.1.100.11:80->172.16.200.55:35254(0.0.0.0:0)
pos/(before,after) 0/(0,0), 0/(0,0)
misc=0 policy_id=1 id_policy_id=0 auth_info=0 chk_client_info=0 vd=4
serial=00002d29 tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
per_ip_bandwidth meter: addr=172.16.200.55, bps=260
npu_state=00000000
npu info: flag=0x81/0x82, offload=8/8, ips_offload=0/0, epid=1/3, ipid=3/1, vlan-
n=32779/0
```

Example IPv6 NP6 session

```
diagnose sys session6 list
session6 info: proto=6 proto_state=01 duration=2 expire=3597 timeout=3600 flags-
s=00000000 sockport=0 sockflag=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0
policy_dir=0 tunnel=/
state=may_dirty npu
statistic(bytes/packets/allow_err): org=152/2/0 reply=152/2/0 tuples=2
speed(Bps/kbps): 0/0
orgin->sink: org pre->post, reply pre->post dev=13->14/14->13
hook=pre dir=org act=noop 2000:172:16:200::55:59145 ->2000:10:1:100::11:80(:::0)
hook=post dir=reply act=noop 2000:10:1:100::11:80 ->2000:172:16:200::55:59145
(:::0)
misc=0 policy_id=1 auth_info=0 chk_client_info=0 vd=0 serial=0000027a
npu_state=0x000c00
npu info: flag=0x81/0x81, offload=8/8, ips_offload=0/0, epid=137/136, ipid-
d=136/137, vlan=0/0
```

Example NAT46 NP6 session

```
diagnose sys session list
session info: proto=6 proto_state=01 duration=19 expire=3580 timeout=3600 flags-
s=00000000 sockflag=00000000 sockport=0 av_idx=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0 policy_dir=0 tunnel=/
state=npu nlb
statistic(bytes/packets/allow_err): org=112/2/1 reply=112/2/1 tuples=2
speed(Bps/kbps): 0/0
orgin->sink: org nataf->post, reply pre->org dev=52->14/14->52 gwy-
y=0.0.0.0/10.1.100.1
hook=5 dir=org act=noop 10.1.100.1:21937->10.1.100.11:80(0.0.0.0:0)
hook=6 dir=reply act=noop 10.1.100.11:80->10.1.100.1:21937(0.0.0.0:0)
hook=pre dir=org act=noop 2000:172:16:200::55:33945 ->64:ff9b::a01:640b:80(:::0)
hook=post dir=reply act=noop 64:ff9b::a01:640b:80 ->2000:172:16:200::55:33945
(:::0)
pos/(before,after) 0/(0,0), 0/(0,0)
misc=0 policy_id=1 auth_info=0 chk_client_info=0 vd=0
serial=04051aae tos=ff/ff ips_view=0 app_list=0 app=0
dd_type=0 dd_mode=0
npu_state=00000000
npu info: flag=0x81/0x00, offload=0/8, ips_offload=0/0, epid=0/136, ipid=0/137,
vlan=0/0
```

Example NAT64 NP6 session

```
diagnose sys session6 list
session6 info: proto=6 proto_state=01 duration=36 expire=3563 timeout=3600 flags-
s=00000000 sockport=0 sockflag=0 use=3
origin-shaper=
reply-shaper=
per_ip_shaper=
ha_id=0
policy_dir=0 tunnel=/
state=may_dirty npu nlb
statistic(bytes/packets/allow_err): org=72/1/0 reply=152/2/0 tuples=2
speed(Bps/kbps): 0/0
orgin->sink: org pre->org, reply nataf->post dev=13->14/14->13
hook=pre dir=org act=noop 2000:172:16:200::55:33945 ->64:ff9b::a01:640b:80(:::0)
hook=post dir=reply act=noop 64:ff9b::a01:640b:80 ->2000:172:16:200::55:33945
(:::0)
hook=5 dir=org act=noop 10.1.100.1:21937->10.1.100.11:80(0.0.0.0:0)
hook=6 dir=reply act=noop 10.1.100.11:80->10.1.100.1:21937(0.0.0.0:0)
misc=0 policy_id=1 auth_info=0 chk_client_info=0 vd=0 serial=0000027b
npu_state=00000000
npu info: flag=0x00/0x81, offload=8/0, ips_offload=0/0, epid=137/0, ipid=136/0,
vlan=0/0
```

diagnose npu np6 session-stats <np6-id> (number of NP6 IPv4 and IPv6 sessions)

You can use the `diagnose npu np6 portlist` command to list the NP6-ids and the interfaces that each NP6 is connected to. The <np6-id> of np6_0 is 0, the <np6-id> of np6_1 is 1 and so on. The `diagnose npu np6 session-stats <np6-id>` command output incudes the following headings:

- `ins44` installed IPv4 sessions
- `ins46` installed NAT46 sessions
- `del4` deleted IPv4 and NAT46 sessions
- `ins64` installed NAT64 sessions
- `ins66` installed IPv6 sessions
- `del6` deleted IPv6 and NAT64 sessions
- `e` is the error counter for each session type

```
diagnose npu np6 session-stats 0
qid   ins44      ins46      del4       ins64      ins66      del6
      ins44_e    ins46_e    del4_e     ins64_e    ins66_e    del6_e
---------------- ---------- ---------- ---------- ---------- ----------
0     94         0          44         0          40         30
      0          0          0          0          0          0
1     84         0          32         0          30         28
      0          0          0          0          0          0
2     90         0          42         0          40         30
      0          0          0          0          0          0
3     86         0          32         0          24         27
      0          0          0          0          0          0
4     72         0          34         0          34         28
      0          0          0          0          0          0
5     86         0          30         0          28         32
      0          0          0          0          0          0
6     82         0          38         0          32         34
      0          0          0          0          0          0
7     86         0          30         0          30         30
      0          0          0          0          0          0
8     78         0          26         0          36         26
      0          0          0          0          0          0
9     86         0          34         0          32         32
      0          0          0          0          0          0
---------------- ---------- ---------- ---------- ---------- ----------
Total 844        0          342        0          326        297
      0          0          0          0          0          0
---------------- ---------- ---------- ---------- ---------- ----------
```

diagnose npu np6 ipsec-stats (NP6 IPsec statistics)

The command output includes IPv4, IPv6, and NAT46 IPsec information:

- `spi_ses4` is the IPv4 counter
- `spi_ses6` is the IPv6 counter
- `4to6_ses` is the NAT46 counter

```
diagnose npu np6 ipsec-stats
vif_start_oid       03ed       vif_end_oid         03fc
IPsec Virtual interface stats:
vif_get             00000000000        vif_get_expired     00000000000
vif_get_fail        00000000000        vif_get_invld       00000000000
vif_set             00000000000        vif_set_fail        00000000000
vif_clear           00000000000        vif_clear_fail      00000000000
np6_0:
sa_install          00000000000        sa_ins_fail         00000000000
sa_remove           00000000000        sa_del_fail         00000000000
4to6_ses_ins        00000000000        4to6_ses_ins_fail   00000000000
4to6_ses_del        00000000000        4to6_ses_del_fail   00000000000
spi_ses6_ins        00000000000        spi_ses6_ins_fail   00000000000
spi_ses6_del        00000000000        spi_ses6_del_fail   00000000000
spi_ses4_ins        00000000000        spi_ses4_ins_fail   00000000000
spi_ses4_del        00000000000        spi_ses4_del_fail   00000000000
sa_map_alloc_fail   00000000000        vif_alloc_fail      00000000000
sa_ins_null_adapter 00000000000        sa_del_null_adapter 00000000000
del_sa_mismatch     00000000000        ib_chk_null_adpt    00000000000
ib_chk_null_sa      00000000000        ob_chk_null_adpt    00000000000
ob_chk_null_sa      00000000000        rx_vif_miss         00000000000
rx_sa_miss          00000000000        rx_mark_miss        00000000000
waiting_ib_sa       00000000000        sa_mismatch         00000000000
msg_miss            00000000000
np6_1:
sa_install          00000000000        sa_ins_fail         00000000000
sa_remove           00000000000        sa_del_fail         00000000000
4to6_ses_ins        00000000000        4to6_ses_ins_fail   00000000000
4to6_ses_del        00000000000        4to6_ses_del_fail   00000000000
spi_ses6_ins        00000000000        spi_ses6_ins_fail   00000000000
spi_ses6_del        00000000000        spi_ses6_del_fail   00000000000
spi_ses4_ins        00000000000        spi_ses4_ins_fail   00000000000
spi_ses4_del        00000000000        spi_ses4_del_fail   00000000000
sa_map_alloc_fail   00000000000        vif_alloc_fail      00000000000
sa_ins_null_adapter 00000000000        sa_del_null_adapter 00000000000
del_sa_mismatch     00000000000        ib_chk_null_adpt    00000000000
ib_chk_null_sa      00000000000        ob_chk_null_adpt    00000000000
ob_chk_null_sa      00000000000        rx_vif_miss         00000000000
rx_sa_miss          00000000000        rx_mark_miss        00000000000
waiting_ib_sa       00000000000        sa_mismatch         00000000000
msg_miss            00000000000
```

diagnose sys mcast-session/session6 list (IPv4 and IPv6 multicast sessions)

This command lists all IPv4 or IPv6 multicast sessions. If a multicast session can be offloaded, the output includes the `offloadable` tag. If the multicast path can be offloaded one of the paths in the command output is tagged as `offloaded`.

The only way to determine the number of offloaded multicast sessions is to use the `diagnose sys mcast-session/session6 list` command and count the number of sessions with the `offload` tag.

```
diagnose sys mcast-session list
session info: id=3 vf=0 proto=17 172.16.200.55.51108->239.1.1.1.7878
used=2 path=11 duration=1 expire=178 indev=6 pkts=2 state:2cpu offloadable
npu-info in-pid=0 vifid=0 in-vtag=0 npuid=0 queue=0 tae=0

path: 2cpu policy=1, outdev=2
        out-vtag=0
path: 2cpu policy=1, outdev=3
        out-vtag=0
path: offloaded policy=1, outdev=7
        out-vtag=0
path: policy=1, outdev=8
        out-vtag=0
path: policy=1, outdev=9
        out-vtag=0
path: policy=1, outdev=10
        out-vtag=0
path: policy=1, outdev=11
        out-vtag=0
path: policy=1, outdev=12
        out-vtag=0
path: policy=1, outdev=13
        out-vtag=0
path: 2cpu policy=1, outdev=64
      out-vtag=0
path: 2cpu policy=1, outdev=68
      out-vtag=0
```

diagnose npu np6 sse-stats <np6-id> (number of NP6 sessions and dropped sessions)

This command displays the total number of inserted, deleted and purged sessions processed by a selected NP6 processor. The number of dropped sessions of each type cam be determined by subtracting the number of successfull sessions from the total number of sessions. For example, the total number of dropped insert sessions is `insert-total` - `insert-success`.

```
diagnose npu np6 sse-stats 0
Counters         SSE0             SSE1             Total
---------------- ---------------- ---------------- ----------------
active           0                0                0
insert-total     25               0                0
insert-success   25               0                0
delete-total     25               0                0
delete-success   25               0                0
purge-total      0                0                0
purge-success    0                0                0
search-total     40956            38049            79005
search-hit       37714            29867            67581
---------------- ---------------- ---------------- ----------------
pht-size         8421376          8421376
oft-size         8355840          8355840
oftfree          8355839          8355839
PBA              3001
```

diagnose npu np6 dce <np6-id> (number of dropped NP6 packets)

This command displays the number of dropped packets for the selected NP6 processor.

- `IHP1_PKTCHK` number of dropped IP packets
- `IPSEC0_ENGINB0` number of dropped IPSec
- `TPE_SHAPER` number of dropped traffic sharper packets

```
diag npu np6 dce 1
IHP1_PKTCHK :0000000000001833 [5b] IPSEC0_ENGINB0 :0000000000000003 [80]
TPE_SHAPER :0000000000000552 [94]
```

diagnose hardware deviceinfo nic <interfac-name> (number of packets dropped by an interface)

This command displays a wide variety of statistics for FortiGate interfaces. The fields `Host Rx dropped` and `Host Tx dropped` display the number of received and trasmitted packets that have been dropped.

```
diagnose hardware deviceinfo nic port2
...
============ Counters ===========
Rx Pkts          :20482043
Rx Bytes         :31047522516
Tx Pkts          :19000495
Tx Bytes         :1393316953
Host Rx Pkts     :27324
Host Rx Bytes    :1602755
Host Rx dropped  :0
Host Tx Pkts     :8741
Host Tx Bytes    :5731300
Host Tx dropped  :0
sw_rx_pkts       :20482043
sw_rx_bytes      :31047522516
sw_tx_pkts       :19000495
sw_tx_bytes      :1393316953
sw_np_rx_pkts    :19000495
sw_np_rx_bytes   :1469318933
sw_np_tx_pkts    :20482042
sw_np_tx_bytes   :31129450620
```

dianose npu np6 synproxy-stats (NP6 SYN-proxied sessions and unacknowledged SYNs)

This command display information about NP6 syn-proxy sessions including the total number proxied sessions. As well the `Number of attacks, no ACK from client` shows the total number of unacknowledge SYNs.

```
diagnose npu np6 synproxy-stats
DoS SYN-Proxy:
Number of proxied TCP connections : 39277346
Number of working proxied TCP connections : 182860
Number of retired TCP connections : 39094486
Number of attacks, no ACK from client : 208
```